GENDER DISPARITY IN ENGINEERING FIELDS:

AN ANALYSIS OF HISTORIC DATA,

AND SCHOOL COUNSELORS'

KNOWLEDGE, VALUES

AND ATTITUDES

by

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STATEMENT OF DISSERTATION APPROVAL

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ABSTRACT

This dissertation investigates the gender disparity in the engineering related fields through three studies. The first study investigates the role of interest in the gender disparity through ACT data over a 30 year period. This study indicated that female interest in engineering related fields has consistently been much lower over this period of time than it has been for male students. Further, results indicate that those who do express interest in engineering related fields are often under prepared. The second study investigated the role of Utah school counselors in the gender disparity. A survey was conducted that established a clear difference between what Utah school counselors believed to be the values and personality characteristics of an engineer based on gender. The last study used this information to inform a nationally distributed vignette that determined that it is likely that school counselors work with students may differ based on the student's gender and perceived personality attributes. This information seems to confirm the need for continued education for both educators and students as to biases and stereotypes that may be influencing female interest in engineering related fields.

I dedicate this dissertation to my family, Magdy and Sonia Iskander and Jason Cox.

Thank you for your support, encouragement and love.

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I would like to first thank my advisors, Dr. Paul Gore and Dr. Cynthia Furse, for all their guidance and encouragement. They have given me the wonderful opportunity to grow as a researcher and have patiently supported me throughout my doctoral training. Dr. Gore has helped me to develop important skills as a psychologist that I will take with me for the rest of my career. Dr. Furse has given me the confidence in myself as a researcher and professional and the chance to turn a conversation in a castle in Italy into one of the most meaningful endeavors of my life.

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CHAPTER 1

INTRODUCTION

Historically, women have been underrepresented in the Science, Technology, Engineering, and Math (STEM) fields. This trend is evident in United States university and workforce statistics. One explanation for this disparity has been gender differences in career-related interests. In fact, differences between male and female interests have been observed for almost 100 years (Thorndike, 1911), and though the root of these differences in interests has been of great debate, differences still remain. The fact that females have consistently expressed interest in social and artistic activities at a higher rate than males, and males continue to express interest in science and technology fields at a much higher rate than their female counterparts (Betz & Fitzgerald, 1987), continues to baffle scientists and policy makers. Gender differences in interests may be a contributing factor to the gender disparity in STEM academic and career choice. However, the differences between male and female career choice may also be influenced by societal factors that contribute to the decision making process. In comparison to females, males not only display greater interest in engineering fields, but also exhibit higher self-efficacy and motivation (Adamson, Foster, Roark, & Reed, 1998; Chen, Chen, Chang, Lee & Chen, 2010; Mantzicopoulo, Patrick & Samarapungavan, 2008; Preckel, Goetz, Pekrum & Kleine, 2008).

The objective of this dissertation is to explore societal factors that may be related to gender differences in STEM academic and career choices. Though many studies have been able to demonstrate interest and career gender disparities, the question of “why” these disparities exist still remains. An understanding of the contextual factors that may be influencing the gender disparity in STEM fields may lead to the identification of new interventions designed to ameliorate those disparities.

The objective and findings of this research are presented in three separate parts. First, we examine historical student interest data in order to further the understanding of this discrepancy from a historical perspective and to identify trends over time. In the first study, 30 years of historical data from the American College Test (ACT) were examined, including ACT test scores, gender, level of preparedness, and intended college major or career aspiration. Statistical Package for the Social Sciences (SPSS) software was used to analyze the data and examine the historical trends in students’ expressed interest in STEM-related careers. Results from this study have been presented at conferences (National Science Foundation, Washington, D.C. 2009; ASEE Austin, Texas 2010) and internationally (Shingua University, Beijing China), and were published in the Journal of Career Assessment (Iskander, Gore, Furse, & Bergerson, 2013). Results from this study clearly identify a significant (although expected) discrepancy between the number of male and female students who expressed interest in engineering majors and careers, along with other novel changes in interest in engineering fields over time. Further, the results suggest that students' reported major and career interests may not be well informed by their academic ability, as we observed significant discrepancies between expressed and measured interests and academic preparedness for STEM fields. These as well as other observations from the ACT data analysis will be presented in Chapter 3.

The first part of this study revealed gender differences in the STEM interest patterns of high school students, as well as gaps between students' interests and their academic preparedness. Because interests are often formally assessed in high school students taking part in structured career exploration and guidance, we chose to next examine the amount and accuracy of knowledge school counselors have about engineering. Further, this part of the study aimed to recognize potential differences that may exist between the knowledge of engineering and attitudes towards engineering careers between male and female counselors.

To investigate the potential school counselor factors in promulgating gender disparity in STEM fields, a survey was developed and distributed to participants at the Utah School Counselors' Annual Conference, as well as at different school counselor workshops throughout the State of Utah. Qualitative and quantitative data analysis methods were used to examine over 100 responses. A description of the survey, participant recruitment, and methods of data analysis are included in Chapter 4. The results of this survey provide important information regarding counselors' attitudes and beliefs regarding female participation in engineering fields. (These results were presented at the 2011 IEEE International Symposium on Antennas and Propagation and URSI Meeting, July 3-8, in Spokane, Washington.)

Results of this survey suggest that school counselors are only moderately informed about the educational requirements associated with postsecondary engineering programs and that they possess somewhat biased attitudes towards the pursuit of engineering-related careers for female versus male students. However, how this bias may impact the work of school counselors is still uncertain. Chapter 5 of this dissertation, and the third study in this project, investigated how these potential biases may operate to influence the career choices of high school students. In this final study, our aim was to better understand the beliefs and recommendations that counselors make to students, using a vignette research design. Specifically, counselors were asked to make judgments about two simulated students who differed only on gender and personality attributes. This information aimed to illuminate the importance of intervention, with school counselors as a key component in reducing the gender disparity in engineering fields. The research questions proposed for this study were based on the idea that school counselors' recommendations to students with respect to college major and academic choices might contribute to the gender disparity in engineering-related fields. Two primary research questions were posed in order to better understand the school counselor-student counseling relationship. The first question is: Do the gender or personality attributes of a student result in different education and career path suggestions? The second research question relates to whether or not the gender of the counselor influences these same suggestions and whether there is a counselor gender by student characteristic interaction. Findings demonstrated that based on student personality attributes and gender, counselors rated specific majors and careers differently. Further, this study exemplified the presence of gender and personality attribute bias in counselors' recommendations for students. The methodology, participants, and results will be discussed in greater detail in Chapter 5. (Results from this part of the research were presented at the 2012 IEEE International Symposium on Antennas and Propagation and USNC/URSI Meeting, July 9-15, in Chicago, Illinois.)

In summary, these three distinct research projects represent a systematic examination of the effects that may be influencing gender disparity in the STEM fields. Further, through this research concrete areas of intervention are suggested. Results from our first study suggest the possibility that societal changes may be influencing the interests of populations of our youth. Results from this study also suggest that a great deal of work is needed in educating high school students about the academic preparedness needed for success in the STEM fields. School counselors are a consistent aspect of each high school student's experience and may be seen as "gatekeepers" of career information and unlike parents or teachers, receive specific training in this area and are expected to possess knowledge of career and academic paths and skills in helping students make sound educational and career decisions. As such, it is important to better understand how their views and attitudes about engineering may in turn affect how they work with students and ultimately how they may be contributing to the gender disparity. Chapter 6 provides an overall summary of the findings of this research and includes suggestions for future work.

CHAPTER 2

LITERATURE REVIEW

For generations it has been observed that females are nearly twice as likely as males to express interests in fields such as arts, education and language, whereas males are more likely to express interests in fields such as science, engineering, and math. Similarly, our review of job incumbent data suggest that women are less well represented in math, science, and engineering fields, being about one-third that of males (Babco, 2000). While females make up almost half of the total workforce, they represent only 25% of the workforce in STEM-related occupations (Babco, 2000; Su, Rounds & Armstrong, 2009). In a recent study, the National Science Board of the National Science Foundation reported that between the years 1983 and 2002 approximately 61% of biology degree recipients and 43% of physical science recipients were female. In contrast, females made up only 21 % of the bachelor's degree recipients in engineering (National Science Board, 2006). A further example of the gender disparity in engineering can be seen in the number of female freshmen with intent to major in engineering. For example, in 1982, 16% of females expressed interest in the major, while this percentage dropped to 14% in 1989 and continued at this level until 1998 (Babco, 2000).

Recent data suggests that female interest in engineering is on the decline from a peak in 2000, and currently only approximately 17% of females express interest in engineering majors (Di Fabio, 2008). In contrast, data suggest that male interest in engineering is on the rise. For example, approximately 80% of engineering students in 2000 were male, whereas in 2008 that number was almost 83% (Di Fabio, 2008). When actual college major counts are examined, clear gender differences emerge. For example, from 1994 to 2007 only 2.7% of college females majored in engineering. This is in stark contrast to the 15.7 % of males majoring in this discipline (Di Fabio, Brandi, & Frehill, 2008).

Given that an undergraduate degree is a prerequisite for enrollment in graduate programs, it is not surprising that gender differences persist in graduate training programs (Babco, 2000). Specifically, in 1980 only 9% of full time engineering graduate students in doctorate-granting institutions were female. Eighteen years later, in 1998, this rate had increased to only 19.6 %. Significantly more pronounced increases were observed in other science- and mathematics-intensive fields, such as biology (e.g., 33.4 % to 45.2 %), and the absolute number of females in these fields is over twice that of engineering (Babco, 2000). It has been reported that although female participation in less mathematics-intensive graduate programs may be as high as 67 %, participation in more mathematics-intensive fields such as engineering has been as low as 17% in recent years (Ceci, Williams, & Barnett, 2009). Thus, although it appears that more female engineering graduates are pursuing graduate degrees relative to recent decades, they continue to be under-represented in graduate engineering programs relative to other science- and math-intensive programs.

These data point to the continued under-representation of females in STEM preparatory undergraduate and graduate programs and further suggest that this gender discrepancy is most pronounced in engineering. This is disquieting, given the significant efforts by government agencies, private organizations and foundations to increase gender diversity in this area. Despite these efforts, female involvement in engineering fields has either continued to decrease or has increased at a disproportionately slow rate for the last 30 years (National Science Foundation, 2007). Efforts and resources allocated to change this long-standing trend of female avoidance of engineering include scholarship opportunities, mentorship programs in a wide variety of K-12 activities, and post-secondary recruitment efforts (NSF, 2007). Specific examples of programs supported by the National Science Foundation include increasing the participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE), Research on Gender in Science and Engineering (GSE), Louis Stokes Alliances for Minority Participation (LSAMP), Research Experiences for Undergraduates (REU), and Research Experience for Teachers (RET; Fordyce, NSF Diversity Update, 2005). Efforts by the National Academy of Engineering in promoting STEM in K-12 classrooms include hundreds of studies and written reports, organization of thousands of extra-curricular activities, and the establishment of dozens of web sites to inform and increase interest in young people of both genders and various age levels (Katehi, Pearson, & Feder, 2009). The lack of apparent impact of these efforts suggests that additional research is needed (Windell, 2010).

Gender differences in interests have been observed for almost 100 years (Thorndike, 1911), and though the root of these differences has been a topic of great interest, debate, and examination, differences still remain. Betz and Fitzgerald (1987) used the six Holland (1973) interest codes (Realistic, Investigative, Artistic, Social, Enterprising, and Conventional) and found significant gender differences in career interests, as demonstrated by higher female interests in working in social and artistic activities and male interest in science, technology and mechanics. Though the difference in interests can, in part, explain the difference in career choice, societal changes over the last 100 years, especially those related to increased acceptance of female participation in the workforce and access to previously inaccessible careers, might be expected to result in the attenuation of gender differences in interests across time.

Career options for women have changed profoundly, and women in the 21st century are pursuing careers at a much higher rate than in the last half of the 20th century. Several major societal events have shaped the role of women in the workforce since the early days of interest measurement and the detection of gender differences. Two of the most profound influences include World War I and the women's rights movement in the 1960s and 70s. During World War I, large numbers of women took paid work in factories and other industries to offset the loss of the male workforce due to military deployment (Savickas & Backer, 2005). Paired with the GI Bill, which permitted over 2 million returning soldiers to attend college upon their return from the war, U.S. female participation in the workforce was forever changed. In 1961, President John F. Kennedy introduced the President's Commission on the Status of Women, which was chaired by Eleanor Roosevelt. A report issued by the Commission in 1963 documented discrimination against women in the workplace and made specific recommendations for improvement, including fair hiring practices, paid maternity leave, and affordable child care. Further changes, including more and more women becoming employed in traditionally male fields such as medicine and law, also occurred (More, 1999). It is therefore surprising, that given these societal changes, very little change has been observed in the engineering workforce over time. The career development and vocational psychology literature may shed some light on gender disparities in engineering.

Social Cognitive Career Theory (SCCT) directly addresses the role of self-efficacy beliefs in career development and choice, and is predominantly concerned with the relationship between personal, environmental, and behavioral variables that are assumed to predict academic and career-related interests and choices (Betz, & Hackett, 1981). Thus, SCCT may offer possible explanations for gender-based differences in career choices and the lack of female interest in STEM majors and careers. This theory proposes that factors such as gender, society and environment have an important impact on the development and implementation of interests and on a person's choice of occupation. Low interest in STEM areas has been identified as one possible explanation for the considerably lower number of women entering the STEM fields, both at the educational and occupational level (Farmer, Wardrop, Anderson, & Risinger; 1995; Lent, et al., 2005; Lent, Brown, Brenner, Chopra, Davis, Talleyrand, & Suthakaran, 2001; Schaefers, Epperson, & Nauta, 1997). Interest has also been identified as a central predictor in educational and occupational choices (Benbow & Minor, 1986; Fouad, 1999).

Career theory and research suggest that interests and self-efficacy beliefs play a pivotal role in informing career considerations, decisions, and implementation (Betz, Harmon, & Borgen 2006; Lent, Brown, & Hackett, 1994, 2000; Su, Rounds & Armstrong, 2009). Interest can be defined as "an attitude or feeling that a certain object or event makes a difference or is of concern to oneself; a striving to be fully aware of the character of an object" (English & English, 1958). Ulrich Schiefele, (1991) defined interest as "a content-specific motivational characteristic composed of intrinsic feeling-related and value-related valences." Lent and his colleagues (2005) concluded, not surprisingly, that interest is an important factor in career goals and choices. Though interest is a factor in the career decision-making process (Betz, Harmon, & Borgen 2006; Lent, Brown, & Hackett, 1994, 2000), the fact that there is a wide gender disparity in engineering majors and careers in the United States that does not always occur globally points to the potential influence of societal factors. These factors can begin at an early age with gender socialization and continue through adolescence with the development of self-efficacy in gender-specific career fields (Bandura, 1986, 1997).

Students with measured interest in science and engineering choose related majors at a higher frequency, and are more persistent in those majors (Aston & Panos, 1969; Lent, Sheu, Gloster & Wilkins, 2010). A recent meta-analysis suggested that interests begin to stabilize in early adolescence (Low, Yoon, Roberts & Rounds, 2005), indicating the importance of early career intervention. Further, vocational interests tend to reflect the activity domains in which a person feels both efficacious and expects to receive favorable outcomes (Lent, Brown, & Hacket, 1994). As social-cognitive variables such as self-efficacy have been repeatedly shown to predict students' interests, goals, persistence and performance this is an important aspect of the decision making process (Bandura, 1986, 1997; Fouad, & Smith, 1996; Lent, Brown & Larkin, 1986).

Findings suggest implicit gender stereotypes are an important factor in the dropout of female students from math-intensive fields (Steffens, Jelenec, & Noack, 2010). Younger female students are often not as supported as their male counterparts when they display interests in science, technology, engineering, and mathematics careers (Kerr, Vuyk, & Rea, 1998). Further, implicit math-gender stereotypes could already be detected in female students as young as 9 years old (Greenwald, McGhee, & Schwartz, 1998). Elementary and secondary school counselors are in a position to positively influence the academic and career choices of the students they advise through encouraging course enrollment and career guidance curriculum and exploration, as well as being liaisons to parents and teachers. Alternatively, school counselors may be contributing to the under-representation of females in STEM through their biases and the resulting academic and career recommendations that they make.

In the United States, the school counseling profession began as a vocational guidance movement at the beginning of the 20th century (Schmidt, 2003). In 1907, English teachers were encouraged to use compositions and lessons to relate career interests, develop character, and avoid behavioral problems (Schmidt, 2003). From this movement grew systematic guidance programs, which later evolved into the comprehensive school counseling programs of today. These programs address three basic domains: academic development, career development, and personal/social development (Schmidt, 2003). Today, school counselors complete 2 years of post-bachelor's education and receive a Master's degree in Education or Educational Psychology. According to the Department of Labor Statistics in the Occupational Outlook Handbook, the job of the school counselor historically entails approximately one-third of their time spent with students conducting career-related counseling (2010). One aspect of the school counselor's job is to utilize students' grades and standardized test scores to provide individual planning for students in order to provide postsecondary education information and aid in planning for future goals. This process involves the counselor providing support as students consider career choices that fit their interests, skill set, and their ultimate career goals. Further, school counselors are often the "gatekeepers" of information about specific careers, what they entail, and whether or not a student's interests correlate with his or her prospective career.

There is already a growing body of research documenting the benefits of school counselor interventions with students. Research suggests that school counselors can promote students' study skills and enhance their achievement levels (Hadley, 1988; Lee, 1993; St. Clair, 1989; Whiston & Sexton, 1998), and can positively influence their career maturity, career exploration, and career decision-making self-efficacy beliefs (Fouad, 1995; Krass & Hughey, 1999; Wahl & Blackhurst, 2000; Whiston & Sexton, 1998).

Research has established that factors such as gender and socioeconomic status have an effect on how school counselors view students (Auwarter & Aruguete, 2008). These authors found that school counselors viewed fictional female students as having lower math abilities than their male counterparts. This study also found that fictional students with a lower socioeconomic background were likely to be seen as having a “less promising future” and lower math ability. Further, it has been demonstrated that stereotypical and biased attitudes are present in the work school counselors do with students (Kane, 1991). This research points to the possibility that stereotypes held by school counselors, especially negatively-held stereotypes pertaining to women in non-traditional careers, may impact how counselors work with and guide their students and that such biases may negatively impact the career and major choices of female students (Kane, 1991). Rodano further suggests that these biases not only hurt and limit career opportunities for female students, but can also be detrimental to male students who seek non-traditional fields and careers (Rodano, 2005). Further, these biases have a disadvantageous effect on our society as a whole, as gender bias that keeps motivated, intelligent and deserving students out of potential careers ultimately hurts communities, professions, and the country (Holcomb-McCoy, 2007).

Given that school counselors influence student decisions and outcome and biases exist in the behavior and attitudes of school counselors, it seems prudent to understand the nature of this bias as it relates to consideration of engineering careers among students and to develop possible interventions. For these reasons, we found it necessary to develop a survey to shed light on unconscious or socially-influenced gender bias in the counseling of students regarding engineering careers and college majors. To this end, vignette methodology was used to understand these influences.

Vignettes were perhaps first seen in qualitative and quantitative research of social judgments in Piaget's work (1932, 1965), when he used "story situations" to investigate moral reasoning in children. Vignettes have continued to be a useful methodology in the social sciences as a way to uncover people’s assumptions, beliefs and bias about a myriad of different topics (Hughes & Huby, 2002). Vignettes are brief stories or scenarios that describe hypothetical people and/or situations, to which a participant is asked to respond. Because the situations are hypothetical, they offer a less threatening way to explore sensitive subjects (Finch, 1987) while still allowing for specific contextual influence on judgment to be examined. Vignette methodology offers a number of benefits, mainly in the ability to elicit data related to potentially sensitive topics about participants’ awareness and attitudes. There is evidence that vignettes offer a way of determining the participant’s cognitive processes utilized in his or her decision-making process. Further, vignette research may inform the researcher regarding which elements of a situation are important in this decision-making process (Morrison, Stettler, & Anderson, 2004).

Vignettes have been shown to address complex issues effectively and economically and allow for the participation of a large number of respondents, thus offering the efficiency of quantitative data while also offering the detail-oriented understanding synonymous with qualitative research (Finch, 1987). The contextualized scenarios presented in vignettes are familiar and concrete, allowing the participant to easily place him- or herself into the situation, and reflect upon how he or she would respond (Morrison, Stettler, & Anderson, 2004; Schoenberg & Ravdal, 2000). Because of their familiar nature, vignettes are often seen as “less threatening” than other forms of research, and therefore give the participant more permission to respond truthfully (Barter and Renold, 2000; Schoenberg and Ravdal, 1999).

As mentioned earlier, many solutions have been proposed to increase female interest in STEM fields. These projects, however, often lack a theoretical foundation and, consequently, have failed to have an impact. Given these observations and existing research; especially that focused on the role of counselor, we undertook three studies to help further understand the past and current gender disparity. The purpose of study one was to provide a comprehensive descriptive portrait of measured and expressed interests in large populations of students from over 30 years of ACT data and to compare those interests to academic achievement level in a recent sample. The purpose of study two was to investigate the knowledge and values school counselors have about engineering fields in order to gain understanding of potential societal factors that may be influencing the gender disparity. The purpose of our third study was to delve more deeply into the biases and assumptions about engineers that were found in study number two. Further, we investigated how these assumptions may influence how school counselors work with students and how these variables may be a contributing factor to the observed gender disparity in the engineering fields.

CHAPTER 3

ACT DATA OVER 30 YEARS

Literature Review

Females are nearly twice as likely as males to express interests in fields such as arts, education and language, whereas males are more likely to express interests in fields such as science, engineering, and math. Similarly, our review of job incumbent data suggest that women are less well-represented in math, science, and engineering fields (about one-third that of males; Babco, 2000). Women make up almost half of the total workforce, but represent only 25% of the workforce in STEM-related occupations (Babco, 2000, Su, Rounds & Armstrong, 2009). In a recent study, the National Science Board of the National Science Foundation reported that between the years 1983 and 2002, approximately 61% of biology degree recipients and 43% of physical science recipients were women. In contrast, women made up only 21 % of the bachelor's degree recipients in engineering (National Science Board, 2006). A further example of the gender disparity in engineering can be seen in the number of female freshman with intent to major in engineering. For example, in 1982, 16% of women expressed interest in the major and this percentage dropped to 14% in 1989 and continued at this level until 1998 (Babco, 2000).

Recent data suggests that female interest in engineering is on the decline from a peak in 2000. Currently approximately 17% of females express interest in engineering majors (Di Fabio, 2008). In contrast, data suggest that male interest in engineering is on the rise. For example, approximately 80% of engineering students in 2000 were male, whereas in 2008 that number was almost 83%. (Di Fabio, 2008). When actual college major counts are averaged across genders, clear differences emerge. For example, from 1994 to 2007 only 2.7% of college females majored in engineering. This is in stark contrast to the 15.7 % of males majoring in this discipline (Di Fabio, Brandi, & Frehill, 2008).

Given that an undergraduate degree is a prerequisite for enrollment in graduate programs, it is not surprising that these gender discrepancies persist in graduate training programs (Babco, 2000). Specifically, in 1980 only 9% of full time engineering graduate students in doctorate granting institutions were women. Eighteen years later in 1998 this rate had increased to only 19.6 %. Although similar increases were observed in other science and mathematics intensive fields, such as biology, (e.g., 33.4 % to 45.2 %), the absolute number of women in these fields is over twice that of engineering (Babco, 2000). It has been reported that although female participation in less mathematics intensive graduate programs may be as high as 67 %, the participation in more mathematics intensive fields such as engineering has been as low as 17% in recent years (Ceci, Williams, & Barnett, National Science Foundation, 2010). Thus, although it appears that more female engineering graduates are pursuing graduate degrees relative to recent decades, they continue to be under-represented in graduate engineering programs relative to other science and math intensive programs.

These data point to the continued under-representation of women in STEM preparatory undergraduate and graduate programs and further suggest that this gender discrepancy is most pronounced in engineering. This is disquieting given the significant efforts by government agencies, private organizations and foundations to increase gender diversity in this area. Despite these efforts female involvement in engineering fields has either continued to decrease or increased at a disproportionately slow rate for the last 30 years (National Science Foundation, 2007). It is encouraging, however, to see that other science related fields are finding ways to entice women into their college majors, but engineering fields seem to still lag behind. Efforts and resources allocated to change this long-standing trend of female avoidance of engineering include: scholarship opportunities for women, mentorship programs in a wide variety of K-12 activities, and postsecondary recruitment efforts (NSF, 2007). Specific examples of programs supported by the National Science Foundation include: increasing the participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE), Research on Gender in Science and Engineering (GSE), Louis Stokes Alliances for Minority Participation (LSAMP), Research Experiences for Undergraduates (REU), and Research Experience for Teachers (RET; Fordyce, NSF Diversity Update, 2005). Efforts by the National Academy of Engineering in promoting STEM in K-12 classrooms include hundreds of studies and written reports, organization of thousands of extra-curricular activities, and the establishment of dozens of web sites to inform and increase interest in young people of both genders and various age levels (Katehi, Pearson, Feder, 2009). The lack of apparent impact of these efforts suggests that research is needed to understand trends in young women’s interests in engineering majors and occupations (Windell, 2010).

From the above discussion, it is clear that gender disparity in STEM subjects and careers is a reality (Su, Rounds, & Armstrong, 2009). Although many government and private agency programs are attempting to provide remedies for improving the situation, thus far, available solutions have provided marginal improvements at best. It seems clear that additional exploration of this gender disparity seems warranted. The career development and vocational psychology literature may shed some light on gender disparities in engineering.

Many studies in career theory and research suggest that interests and self-efficacy beliefs play a pivotal role in informing career considerations, decisions, and implementation (Betz, Harmon, & Borgen 2006; Lent, Brown, & Hackett, 1994, 2000, Su, Rounds & Armstrong, 2009). Social cognitive variables, such as self-efficacy have been repeatedly shown to predict students' interests, goals, persistence and performance (Bandura, 1986, 1997; Fouad, & Smith, 1996; Lent, Brown & Larkin, 1986). For example, students with measured interest in science and engineering choose related majors at a higher frequency, and are more persistent in those majors. A recent meta-analysis suggested that interests begin to stabilize in early adolescence (Low, Yoon, Roberts & Rounds, 2005), indicating the importance of early career intervention. Further, vocational interests tend to reflect the activity domains in which a person feels both efficacious and expects to receive favorable outcomes (Lent, Brown, & Hacket, 1994).

There have been a number of theories offered to explain the gender disparity in engineering. Recent theories proffered by vocational psychologists emphasize the central role that career and academic interests play in the career decision-making of young males and females. Evidence in support of this role is mounting (Farmer, Wardrop, Anderson, & Risinger; 19955; Lent, et al., 2005; Schaefers, Epperson, & Nauta, 1997). Thus it is important to consider expressed interests when examining gender differences in career aspirations or attainment. Interest can be defined as “an attitude or feeling that a certain object or event makes a difference or is of concern to oneself; a striving to be fully aware of the character of an object” (English & English, 1958.) Ulrich Schiefele, (1991) defined interest as “a content-specific motivational characteristic composed of intrinsic feeling-related and value-related valences.” Lent, Brown, Sheu, Schmidt, Brenner, and Gloster (2005) concluded, not surprisingly, that interest is an important factor in career goals and choices.

It also appears that self-efficacy (including STEM related) beliefs are important determinants of college major choice and performance. Self-efficacy beliefs are developed through a number of psychological mechanisms – the most influential being personal performance accomplishments. The Social Cognitive Career Theory (SCCT) is predominantly concerned with the relationship between personal, environmental, and behavioral variables that are assumed to predict people’s academic and career-related interests (Betz, & Hackett, 1981). The roots of SCCT are in Bandura’s (1986, 1997) general social cognitive theory and research, which suggests that there is a relationship between social cognitive interests, and career choices. Thus, SCCT may provide possible explanations of gender-based differences in career choices and the lack of female interest in STEM majors and careers. This theory proposes that factors such as gender, society and environment have an important impact on the development and implementation of interests and on a person’s choice of occupation. Interests are thought to be a potential contributing factor in the gender disparity in the STEM fields. They have been identified as a critical explanation for the considerably lower number of women entering the STEM fields both at the educational and occupational level (Farmer, Wardrop, Anderson, &

Risinger; 1995; Lent, et al., 2005; Lent, Brown, Brenner, Chopra, Davis, Talleyrand, & Suthakaran, 2001; Schaefers, Epperson, & Nauta, 1997). Interest has also been identified as a central predictor in educational and occupational choices (Benbow & Minor, 1986; Fouad, 1999).

The disparity between male and female interests has been observed for almost 100 years (Thorndike, 1911), and though the root of these differences in interests has been of great debate, differences still remain. The fact that women have consistently expressed interest in social and artistic activities at a higher rate than men, and men continue to express interest in science and technology fields at a much higher rate than their female counterparts (Betz and Fitzgerald, 1987), has baffled scientists and policy makers for many years. Betz and Fitzgerald (1987) used the six Holland (1973) interest codes (Realistic, Investigative, Artistic, Social, Enterprising, and Conventional) and found significant gender differences in career interests, as demonstrated by women's higher interests in working in social and artistic activities and men's interests in science, technology and mechanics. Though the difference in interests can, in part, explain the difference in career choice between men and women, these differences may reflect a longstanding trend of male interest in engineering, perhaps leading to greater motivation, and self-efficacy in comparison with females (Adamson, Foster, Roark, & Reed, 1998; Chen, Chen, Chang, Lee & Chen, 2010; Mantzicopoulo, Patrick & Samarapungavan, 2008; Preckel, Goetz, Pekrum & Kleine, 2008).

As mentioned earlier, many solutions have been proposed to increase women's interest in STEM fields. These projects, however, often lack a theoretical foundation and, consequently, have failed to have an impact on the central variables including interest and preparation. These variables must be clearly recognized and acknowledged in order to nurture and sustain occupational interests and choices (Lent, Sheu, Gloster, Wilkins & Betz, 2008). Moreover, many of these efforts do not consider the existing interests of their participants. For example, it stands to reason that interventions designed to increase consideration of STEM careers would be more successful when targeting students with measured interests that are consistent with such career choices compared to interventions aimed at changing the interests of students with non-STEM interests. Thus it might be helpful to understand the role "measured interests" plays by examining a large representative sample of high school students. The presence of large numbers of students with measured interests in STEM congruent domains but who express interest in non-STEM areas would suggest a possible target population for interventions such as those described above. Equally important, however, is the possibility that many individuals with expressed or measured interests in engineering may not possess the specific aptitudes necessary for success in engineering-related fields. An individual with high levels of measured and expressed interests in engineering but with poor math and science skills or past performance requires a different type of intervention compared to a student with high levels of math and science performance but with no expressed interest in the STEM fields. In the latter case, exposure to career information, modeling, or experience with engineering fields might be appropriate whereas in the former case, academic remediation might be indicated.

By observing measures of interest and academic preparedness over an historical period one might be able to identify clear trends in the number of students with interest but who lack preparation, as well as the number of students with preparation who fail to express interest. An understanding of this information will allow better utilization of the current resources and also may better guide new ideas for avenues to reverse these trends.

Also, knowledge of what type of student expresses interest in engineering may provide an insight into what is working thus far, while knowledge of the discrepancy between those who lack preparedness with expressed interest may illuminate interventions that may be better suited for the classroom.

The objective of this work, therefore, is to present results of a study that examined historical changes in expressed interest and career occupation over a long period of time (30 year span) to help infer some of the societal influences that may have contributed to these changes. Further, most available studies focused on college enrollment and adopted careers, but thus far, no studies have looked at differences in high school student interest in the different STEM majors and careers. Therefore, the importance of this study is the focus on examining ACT data for high school students to help analyze their expressed interest in STEM majors and engineering careers. Obtained results not only further highlighted historical trends in gender differences of interests in STEM majors and career, but also help in identifying avenues for reversing this trend. The ACT data analysis method and calculations procedure are described in the Chapter 3 including summary of the obtained results, observations from the data analysis and discussion on how these observations may lead to the reversal of this historic gender disparity trend in female participation in STEM/engineering majors and careers.

Participants

The participant pool included all high school students with complete data sets (sufficiently complete interest inventories to be scored) in the ACT archival database from the years 1973 to 2007. Participants resided in all 50 states and the District of Columbia, and represented a range of demographic characteristics (e.g., socioeconomic status, gender, race, community size, graduating class size, and high school achievement). It is reasonable to assume that the participants were generally in the college-bound population, or else they would not have been taking the ACT exam. The total number of students in this pool exceeded 38 million.

Sample sizes gradually increased from 744,050 in 1974 to 2,037,479 in 2006 due to several factors, including an increasing number of students aspiring to go to college and the increased market share enjoyed by ACT relative to its competitor SAT. Females outnumbered males during early study years (e.g., 53% vs. 47%, respectively in 1974) and even more predominantly in later study years (e.g., 56% vs. 44%, respectively in 2006). Not surprisingly, racial/ethnic diversity continued to increase across the study years. For example, in 1974, over 70% of sample participants were White (6% African American, 2.5% American Indian, and 2.5% Hispanic/Latino). In contrast, in 2006, Whites made up only 63% of examinees (11% African American, 1% American Indian, and 8% Hispanic/Latino, and 3% Asian American).

Procedure

The method is based on analyzing the expressed interest in STEM courses and careers by high school students who took the ACT exam over a 30-year period (1974 - 2006). Over 38 million high school students took the ACT over this period, responding to questions beyond the ACT test, including demographic information and interest in career and college majors.

Specifically, the ACT College Entrance Exam contains a student profile section, demographic information, and sections for reading, mathematics, science, and English. The profile section contains 190 questions, of which 79 questions relate directly to high school activities, interests, and accomplishments outside of the classroom (ACT, Inc., 1995). These questions relate to students' activities in a variety of disciplines and interest areas, e.g., instrumental music, vocal music, student government, etc. They also include student-selected career and college major aspirations and are answered in yes/no format (ACT, Inc. 1995).

Expressed interest in academic major and career choice was assessed on the ACT registration profile using items 13 (What is your first choice occupation?) and 14 (How sure are you about your current choice of college major?). Students were presented with 271 choices that included 25 engineering and 3 computer science majors. Students were also asked how certain they were of their college major and career choice (Very Certain, Fairly Certain, Uncertain). Only students who indicated that they were fairly or very certain of their choice were included in subsequent analyses, thus ensuring that students with measured interests were the focus of this study.

Mathematics preparation has been consistently observed to be an important measure for student success and retention in STEM fields (Wei-Cheng & Richard, 2001). Sixty of the 215 total ACT cognitive assessment questions are mathematics-related, and mathematics is the longest section, taking about 1 hour of exam time (ACT.org). The ACT mathematics composite test score was, therefore, used to evaluate the relationship between career aspirations and mathematics preparation.

For this project, three groups were created to capture differing levels of mathematics achievement. Highly prepared students included those with an ACT mathematics score greater than or equal to 28, moderately prepared students included those with ACT mathematics scores between 19 and 27, and inadequately prepared students had ACT mathematics scores less than or equal to 19. The higher-bound cutoff score used in this study was based on the cutoff scores for entrance into the engineering program at the University of Utah, while the lower-bound cutoff score is based on the average minimum entrance ACT score for state colleges and universities across the western United States, including the University of Utah, Idaho State, and California State University (Testing Requirements, 2009; Freshman, (nod) & Freshman Admission Requirements, 2007).

Analysis was conducted using SPSS software from IBM (SPSS.com, 2010). Analysis procedures included the calculation of descriptive statistics, as well as an analysis of the proportion of all students expressing interest in engineering careers using the three levels of mathematics score categories described above. Additionally, cross-tabulations were calculated to determine the interest patterns of students in reference to their math scores. Data was also analyzed to compare female and male interest in engineering over the period of 1974-2006, as well as to highlight the levels of preparation of females and males for some engineering disciplines.

Results

This paper focuses on the question of gender differences in interest in engineering related fields over a 30-year span. Engineering fields have seen a significantly startling gender disparity relatively consistently over the last 30 years. In some fields, such as electrical engineering, this gender disparity significantly increased in the early 1980's when male interest increased and female interest remained stagnant. This observation has been theorized to be due to societal factors occurring during that time. Conversely, in more directly computer related fields, when both male and female interest peaked in the 1980's, the gender disparity reached an all-time low. These observations are important aspects of our understanding of interest and how it relates to the gender disparity we observe in engineering related fields.

Student-expressed interests. Figure 3.1 shows the percentage of student-expressed interest in all engineering majors from the ACT historical data, and strongly suggests that gender differences, which have existed since the early 1970s, persist to this day. For example, about 1% of female students who took the ACT in the 1970s expressed interest in engineering. After a modest increase in the 1980s and 90s, about 1% of female students continued to express interest in engineering in 2005. Figure 3.1 also shows that the modest increase in female interest in engineering of about 2-3% during the 1980s was much lower than the12-13% surge in male interest during this period. It is, however, important to note that female interest held steady at about 2% during the 1990s, while male interest in engineering majors experienced a steady and steep decline during this period. One of the most alarming trends is the fact that the interest in engineering majors appears to have steadily declined for both females and males since the observed peaks in the early to mid-1980s.

Figures 3.2 and 3.3 show the expressed interests of male and female students in two engineering college majors (electrical and mechanical engineering) and highlight the importance of historical analyses of interests. As may be noted, pronounced gender differences can be observed in both majors. While male interest in electrical engineering is on the decline, male interest in mechanical engineering has risen progressively since 1974. Female interest in these disciplines, however, has remained relatively stagnant in both majors during that same time period. The trend in male interest in electrical engineering may be attributable to the "dot com" era and the rise of personal computers and their associated hardware and applications during the 1980s. This trend of the rise and fall of interest is not seen in mechanical engineering, which has had a steadier rise over time. Similar to results seen for electrical engineering, however, female interest has not changed significantly during this period for either major.

Figure 3.4 shows student interest in computer engineering. The very strong peak expressed during the early 1980's was similar for both male and female students. This peak was also seen in the electrical engineering major for male but not female students. The expressed interest peaks seen in Figure 3.4 are the most profound of all of the engineering majors examined in this project. Within a 6-year period, expressed interest in computer and information sciences increased nearly fourfold, while in subsequent years these areas experienced equally precipitous drops. A similar spike can be observed in the mid- to late 1990s, but only for male students. Notably, female interest did not experience this second peak.

Figure 3.5 shows results from an analysis of engineering college major and occupational interests of students by past achievement (ACT math scores). This research analyzes the last year (2006) of the available data in order to help understand the current level of disparity between interest (intended college major) and actual measured ability (student's ACT score). As previously described, students who have ACT math scores below 19 were considered to be poorly prepared; those with scores of 20-27, marginally prepared, and those who scored 28 or above, completely prepared for their intended college major. By examining majors where the majority of students are poorly or marginally prepared, we can foresee probable challenges for retaining students in these majors, despite their expressed interest. The data in Figure 3.5 clearly highlight that large numbers of students who are expressing interests in engineering-related college majors and careers may be poorly or only marginally prepared to succeed in these pursuits. This observation is particularly true for students expressing interests in computer-related engineering majors and general engineering. In contrast, students expressing interest in aerospace, biological, chemical, and mechanical engineering majors appear to have proportionately stronger preparation in high school mathematics.

Figure 3.6 presents results showing the number of students in each achievement group who expressed interest in engineering for the year 1982 (previously identified as a peak year of interest in engineering). It is clear from this graph that the relative proportion of highly prepared students (i.e., ACT score >=28) across almost all engineering disciplines (with the exception of chemical engineering) is less than the number of students in the two other lower achievement groups.

Figure 3.7 shows female students' major interest data versus ACT scores (academic achievement) presented separately for female students. As may be noted from these results, females who expressed interest in engineering, particularly in chemical, biology, and aerospace engineering, are more likely to be in the prepared category in comparison to computer related fields. However, when comparing the ratio of respondents it seems that overall, females who report interest in engineering fields are as underprepared as their male counterparts.

Conclusions

This 30 year study of ACT historical data was conducted in order to gather informational trends about students' interest. Results from the present study clearly demonstrate a historically sustained presence of gender differences in expressed engineering interests. For both electrical engineering and general engineering, a peak occurred in the early 1980s. This peak was seen in male students whose interest increased from 4% to 12%. A similar peak, however, was not observed in female interest. Conversely, in computer engineering, there was a peak in both male and female students' interest in the early 1980s, with each increasing about 6 to 10%. Interestingly, though, the second peak in computer engineering seen in the late 1990s resembled that of other engineering fields, with no notable increase in female interest, but an increase in male interest of about 10%.

These gender disparities could be due to many societal influences. By extending our understanding of these gender differences through an historical perspective and analysis by engineering subspecialty, we were able to see the prevalence and longstanding nature of the disparity, while also gaining an understanding of potentially unseen influences that could be affecting this disparity. Understanding the interest patterns is an important aspect in understanding the work force, hiring patterns, and recruitment in engineering-related fields. These results highlight the probability that sociocultural events, such as the emergence of the internet and personal computers (1980s), "dot com" boom (1990s), and emergence of computer games (late 1990s), etc., can have immediate and relatively profound influences on the expressed interests of American youth. The historical differences in interest in engineering- related fields are especially captivating, due to the differences seen in some engineering subspecialties (such as computer engineering) more than others (such as mechanical engineering). The 1980s were a bleak time for female interest in most engineering fields, while male interest at this time hit an all-time high. Interestingly, at this time the only subspecialties that encountered female interest peaks were the computer-related fields. By the late 1990s and early 2000s, male interest was once again increasing in the computer-related fields, but female interest in other engineering-related fields did not have the same experience. Female interest in electrical engineering, for example, has stayed relatively stagnant at less than 1% over the last 30 years. This is also the case with mechanical engineering, where, despite the increasing interest of male students, the percent of female students interested in this field has stayed well below 1%. This contrasts with the new field of computer and information systems, which saw a peak of both male and female interest in the early 1980s, with female interest reaching a high of almost 10%. The interest gap has widened since that time, and has held at a constantly low 2% for female students, even when male interest peaked again in the early 2000s. The newness of the computer field during the early 1980s could have something to do with the lack of gender disparity and high interest from both male and female students in the early years. The subsequent drop in female interest since then is on par with other engineering- related fields, and thus may be explained by the decreased appeal of this field over time.

These trends are further confirmed by examining the differences in the graduating engineering class of the University of Utah from 2002 and 2009. The University of Utah graduated 362 students with their bachelor’s degrees in engineering in 2009. This is up from 2002, at which time the number of graduates was only 257. This increase, unfortunately, does not necessarily reflect an increase in engineering overall, but rather, in specific concentrations. The biomedical engineering department did not exist in 2002, but in 2009 it contributed 21 graduates, 10 of which were female (obia.utah.edu, 2010). The biomedical and mechanical engineering departments alone accounted for about 70% of the growth seen in the last 7 years, reflecting the earlier-discussed data that mechanical engineering is one of the few major departments that are on the rise in the U.S. Also, parallel with the previous data is the fact that women at the University of Utah are greatly underrepresented in the graduation numbers compared to their male counterparts. Even for growing fields such as mechanical engineering, only 12 graduates were female in comparison to the 107 male graduates. This information demonstrates that the lack of female interest persists from the time that high school juniors and seniors take the ACT all the way through to college and graduation, thus leaving a lack of female engineers in the workforce and in graduate programs. It seems then, that necessary steps must be taken early to reverse this trend in a student's career, and decrease disparity in female participation in engineering careers.

Another very interesting analysis from the ACT data is the combination of expressed interest and math preparation. The disparity in interest and skills is particularly seen in computer fields, where students' math preparation level is much lower than in other fields. Students may think that they are interested in computer science because they play computer games, but they have not been able to achieve the required level of mastery in math (as measured by their lower ACT scores). As a result, they may be poorly prepared to succeed in this major. For these poorly-prepared students expressing interest in the field, it appears they are over-confident in their abilities, perhaps because of lack of advising and misinformation. Students expressing interest in these fields may require advising and encouragement at an earlier level to ensure that they take the necessary preparatory classes. Additionally, universities should be made aware of the differences between preparations for the different majors to help them define best practices for remediation for students with interest but poor or marginal preparation.

Interestingly, the preparation of females and males who are interested in STEM fields are markedly similar, despite the much greater number of male students. Female students seem to display the same lack of understanding and preparedness as their male counterparts. For instance, the proportion of female students who report interest in the

STEM fields are moderately or poorly prepared (as measured by the ACT math score at or below 27) about 75% of the time. This is almost exactly equal the proportion of moderately or poorly prepared males who express interest in STEM fields. Students who express interest in computer-related STEM fields are even more likely to be under-prepared for their major. The proportion of both male and female students who were moderately or poorly prepared for the major was about 85-90%.

Our preliminary analysis of the relationships between expressed interest and math achievement highlight the importance of early and aggressive educational guidance beginning as early as high school. Clearly, students with math achievement scores lower than 19 on the ACT will struggle in most paraprofessional engineering training programs, yet there appear to be large numbers of these students who express interest in engineering. High school counselors might use data such as those shown in Figure 3.5 in an effort to help students identify more realistic career options or to target students for effective math remediation. Policymakers, educators, colleges, and employers may use this data to understand the engineering pipeline and use this knowledge to better prepare both young men and women for careers in STEM fields.

Based on these trends, it appears likely that the information students obtain and how they perceive these fields are skewed and may not accurately represent the actual work done in each discipline or the preparation required for entering the field. All of these fields are highly scientific and require strong math skills. Therefore, if a student really understood the type of work in that discipline, it is likely he or she would be more interested in both math and computer science, for example, and therefore have taken more of these courses, which would probably have resulted in a higher ACT math score.

Given the identification of "interested but marginally prepared" students, we intend to follow up with additional analyses that will enable us to identify "prepared but not interested" students and students who are mathematically prepared and have measured interests congruent with engineering-related fields, but who express interests in nonengineering fields. This last category of students might represent a viable recruitment pool for engineering programs. It is plausible that students in this category have not been exposed to engineering-related experiences or career information. Later analyses on ethnicity, demographic information and socioeconomic status will also be conducted in order to gain further understanding regarding students who are interested in STEM fields and to identify variables such as ethnicity and socioeconomic status that represent classes of students who require more attention and may benefit the most from interventions (Hackett, Betz, Casas, & Rocha-Singh, 1992).

One such intervention may be to coordinate with high school career counselors in order to obtain information on exactly how students are being counseled and guided towards choosing their majors. For instance, a survey for school counselors is being developed in order to gain a better understanding of what a college counseling session may look like. A vignette study is also in development in order to pinpoint potential areas of bias in the major and career guidance given to students. This information will allow us to continue to identify leaks in the "pipeline" in order to rectify the current situation (Hanson, Creswell, Clark, Petska, & Creswell, 2005).

These observations also make a case for continued efforts to encourage young women to enter engineering and related careers through early intervention from teachers and guidance from counselors (Sonnert, Fox, & Adkins, 2007). Based on existing research, such efforts should focus not only on identifying and promoting math, science, and engineering interests in young women, but also on improving the past math and science achievement of these students. Strong past achievement is likely to be associated with strong positive self-efficacy beliefs, which, according to the literature, are potent determinants of behavioral initiation and persistence (Lent, Lopez, Brown, & Gore, 1996).

Furthermore, educators and policy makers could target students with strong academic backgrounds who both have expressed interests congruent with engineering and are not explicitly aspiring to engineering-related careers with interventions designed to enhance awareness of engineering careers. Alternatively, academic enrichment programs might be targeted to students with measured and expressed interests, but who lag behind in their academic preparation. These as well as other related issues will be analyzed and discussed in future publications.

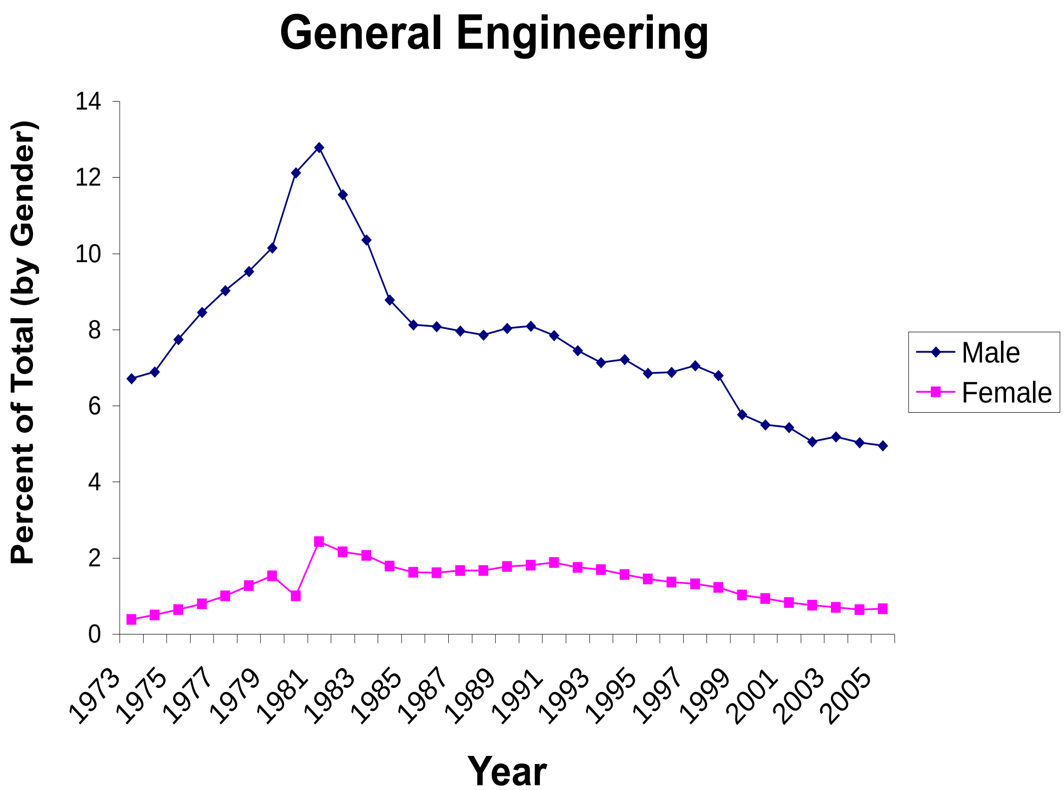

Figure 3.1

ACT historical data of expressed interest in General Engineering

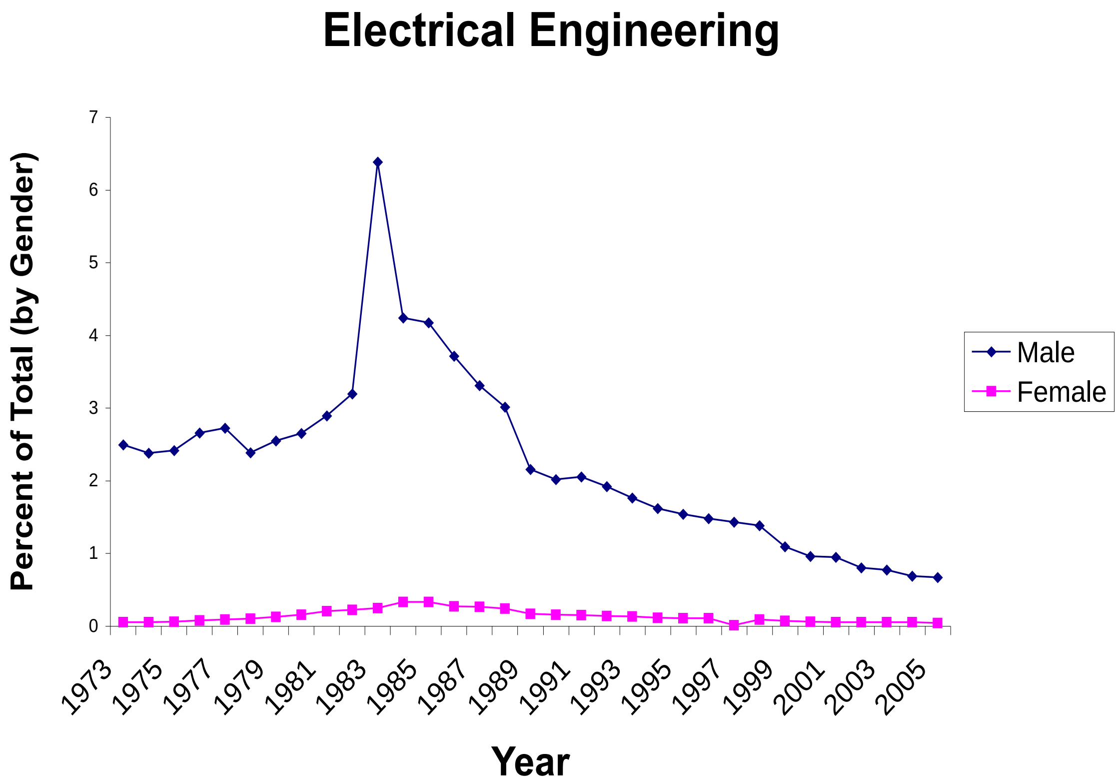

Figure 3.2

ACT historical data of expressed interest in Electrical Engineering

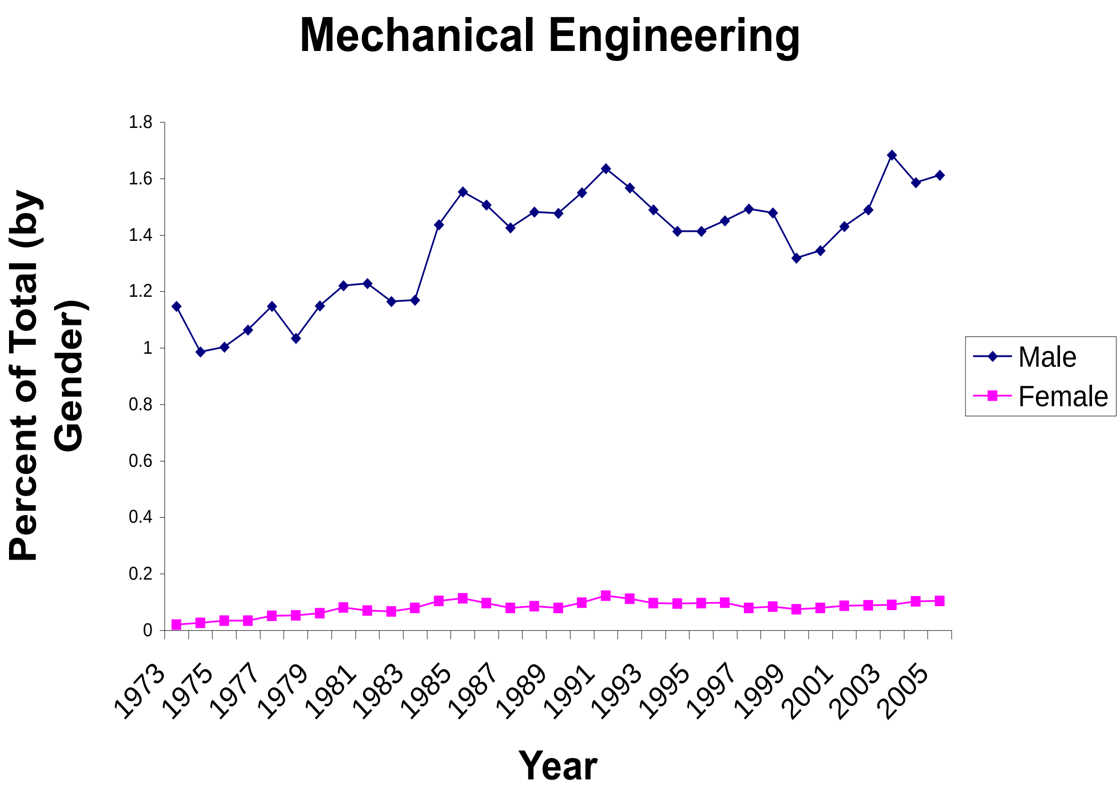

Figure 3.3

ACT historical data of expressed interest in Mechanical Engineering

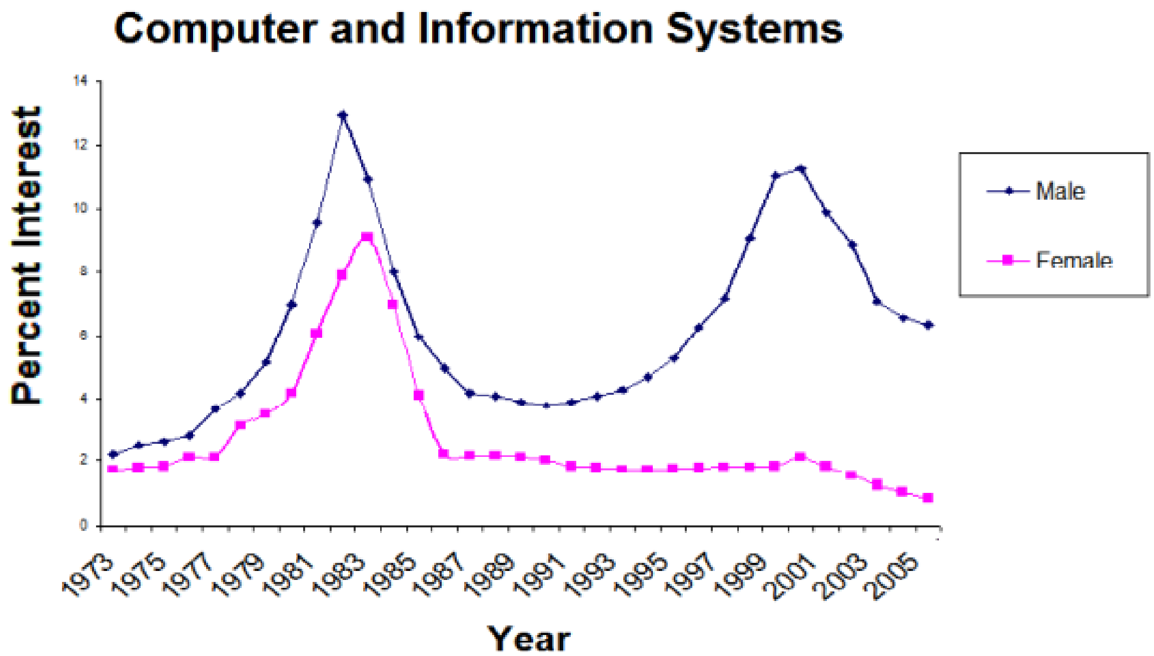

Figure 3.4

ACT historical data of expressed interest in Computer and Information Systems

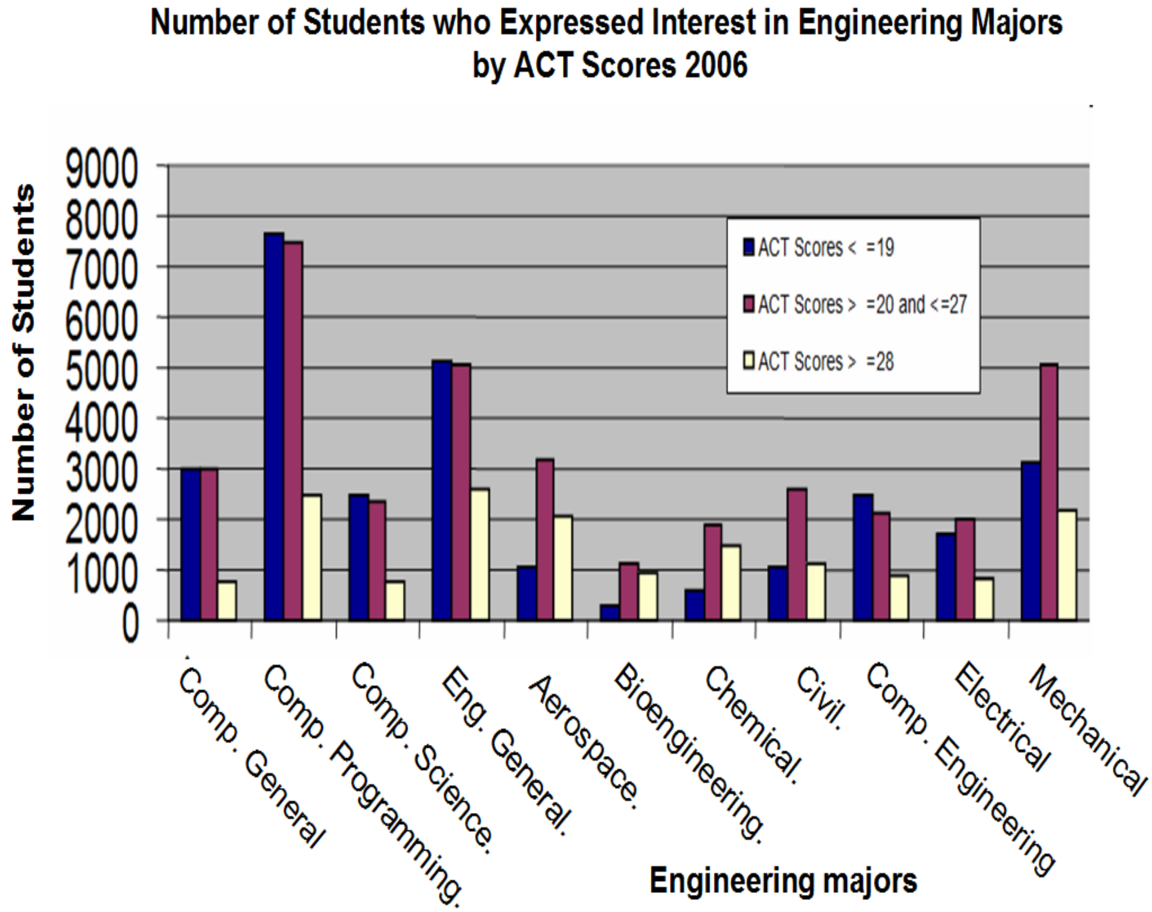

Figure 3.5

ACT data of students expressed interest in engineering majors

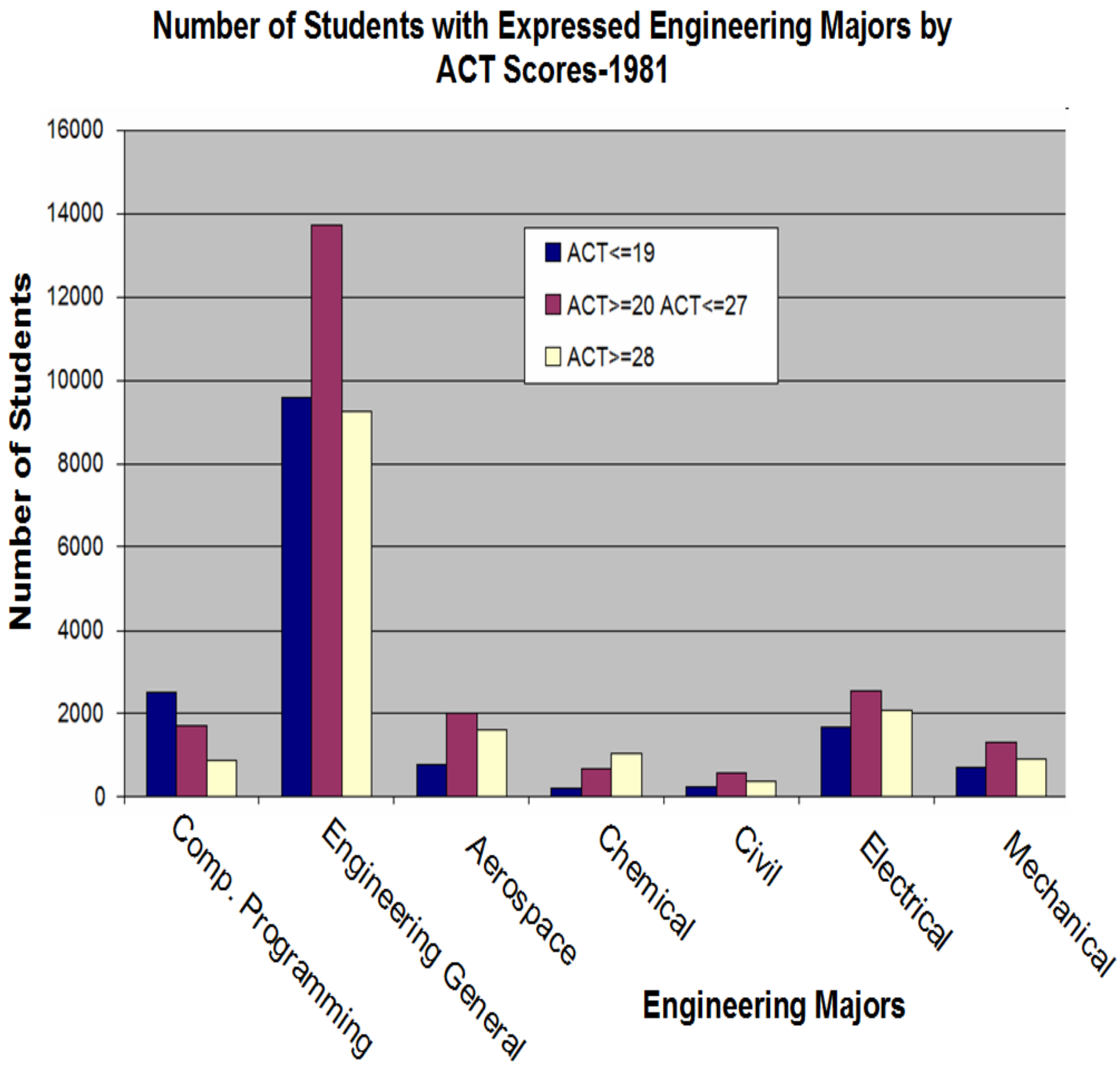

Figure 3.6

ACT data of students expressed interest in engineering majors in 1981

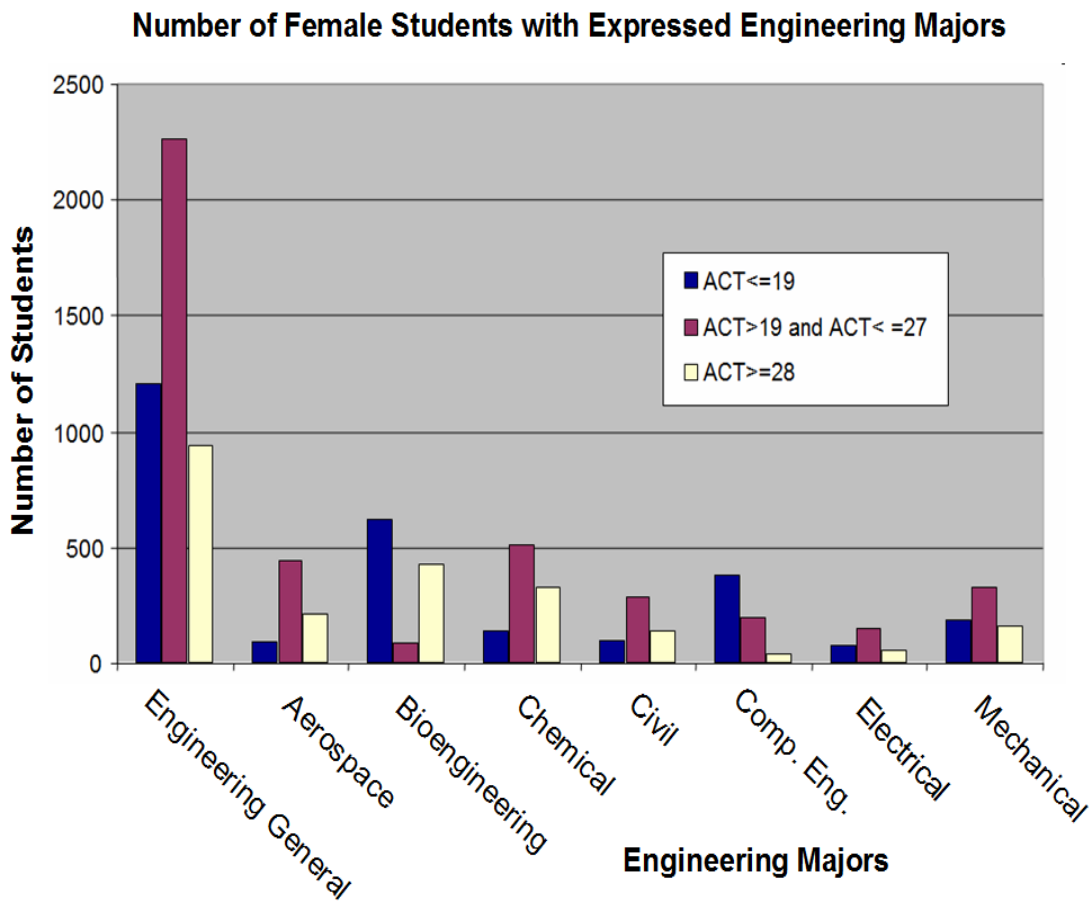

Figure 3.7

ACT data for female students expressed interest in engineering majors in 2006

CHAPTER 4

UTAH SCHOOL COUNSELOR SURVEY

Literature Review

There is a continued demand for a more diverse engineering workforce. Recent estimates from the U.S. Department of Labor (www.bls.gov/ooh) suggest that employment in engineering fields will grow between 6% and 62% in the next decade, with differences being noted based on engineering specialty area. Most labor force experts agree that continued growth in national productivity requires a supply of engineers who are highly competent in mathematics and science and adaptable to the needs of a rapidly changing profession (U.S. Department of Labor, 2008). Unfortunately, the under-supply of engineers is now recognized as a potential threat to the economic competitiveness of the U.S., as the country continues to be outpaced in producing engineering graduates. In 1970, for example, American citizens constituted half of all science and engineering doctorates in the world, whereas by the year 2010, Americans only held 15% of doctorates in these fields. Further, as many Asian countries, specifically China, Japan and Korea, experienced 40% to 100% growth in their production of engineering graduates over the last 20 years, the U.S. experienced a 20% decline (National Science Board, 2004), and expressed interest in engineering declined by over 30% among college-bound students in the U.S. during that same time period (ACT, 2008).

Perhaps even more disconcerting is the disproportionately low representation of females in these fields. Recent data suggests that female interest in engineering is on the decline from a peak in 2000. Currently, only 17% of females express interest in engineering majors (Di Fabio, 2008). Similar gender disparities are seen at the occupational level (U.S. Department of Labor, 2008). An example of the gender disparity in engineering can be seen through historical data of the number of female freshmen with intent to major in engineering (Iskander, Gore, Furse, & Bergerson, 2011). In 1982, only 16% of women expressed interest in the major, and this percentage dropped to 14% in 1989 and continued at this level until 1998 (Babco, 2000). This is disquieting, given the significant efforts by government agencies, private organizations and foundations to increase gender diversity in this area. The gender disparities observed in this profession persist despite efforts to promote increased participation (National Science Foundation, 2007).

Lack of interest in engineering among women is one possible explanation for the gender disparities in the engineering workforce. Gender differences in interests have been observed for almost 100 years (Thorndike, 1911), and though the cause of these differences in interests has been of great debate, differences still remain. Hackett and Betz, among others, suggest that differences in math and science self-efficacy beliefs, perhaps a result of differential access to experience or encouragement, may account for difference in math and science interests between young male and female students (Hackett & Betz, 1981; Betz & Hackett, 1981). According to social cognitive career theory, self-efficacy is a belief in one's own ability to succeed in actions in the pursuit of a goal. Over 40 years of research have established self-efficacy beliefs as determinants of behavior and success. Recent research clearly establishes the relationship between math and science self-efficacy beliefs and interests. Students with strong positive math and science self-efficacy beliefs are more likely to express interests in, and pursue, math- and science-focused college majors and careers (Lent, Sheu, Gloster & Wilkins, 2010).

Elementary and secondary school counselors are in a position to positively influence the academic and career choices of the students they advise through encouraging course enrollment, through career guidance curriculum and exploration, and as liaisons to parents and teachers. School counselors are also in a position to perpetuate gender differences in advanced high school math and science course-taking behavior and dissuade female students from attending college or pursuing math- and science-intensive academic majors. As such, school counselors have the potential to either contribute to, or ameliorate, the gender disparity that continues to elude researchers and thwart policymakers' efforts. Given their importance in the initial educational and career decision-making process, the attitudes and beliefs of school counselors with respect to engineering careers warrant further investigation.

In the United States, the school counseling profession began as a vocational guidance movement at the beginning of the 20th century (Schmidt, 2003). In 1907, English teachers were encouraged to use compositions and lessons to relate career interests, develop character, and avoid behavioral problems (Schmidt, 2003). From this movement grew systematic guidance programs, which later evolved into the comprehensive school counseling programs of today. These programs address three basic domains: academic development, career development, and personal/social development (Schmidt, 2003). Today, school counselors complete 2 years of post bachelor's education and receive a Master's degree in Education or Educational

Psychology. At the University of Utah, this curriculum provides theoretical and practical foundations in the following areas: “foundational knowledge in counseling; counseling and career education for K-12 students; organization and administration of school counseling and guidance services; and the integration of professional and ethical practices in school counselor identity development” (http://ed-psych.utah.edu/school-counseling/). According to the Department of Labor Statistics in the Occupational Outlook Handbook, the job of the school counselor historically entails approximately one-third of their time spent with students conducting career-related counseling (2010). Though school counselors engage in a variety of activities, one focus, specifically in the state of Utah, is to use a student’s grades and standardized test scores to conduct a 1 hour meeting with each student in order to discuss postsecondary education and future goals. This process involves the counselor providing support as students consider career choices that fit their interests, skill set, and their ultimate career goals. Further, school counselors are often the “gatekeepers” of information about specific careers, what they entail, and whether or not a student’s interests correlate with the career. There is a growing body of research documenting the benefits of school counselor interventions with students. Research suggests that school counselors can promote students' study skills and enhance their achievement levels (Hadley, 1988; Lee, 1993; St. Clair, 1989; Whiston & Sexton, 1998) and can positively influence career maturity, career exploration, and career decision-making self-efficacy beliefs (Fouad, 1995; Krass & Hughey, 1999; Wahl & Blackhurst, 2000; Whiston & Sexton, 1998).

Research has established that factors such as gender and socioeconomic status have an effect on how school counselors view students (Auwarter & Aruguete, 2008). This research established that school counselors viewed fictional female students as having lower math abilities than their male counterparts (Auwarter & Aruguete, 2008). It also found that fictional students with a lower socioeconomic background were likely to be seen as having a “less promising future” and lower math ability. Further, it has been demonstrated that stereotypical and biased attitudes are present in the work school counselors do with students (Kane, 1991). This research points to the possibility that stereotypes held by school counselors, especially negatively-held stereotypes pertaining to women in nontraditional careers, may impact how they work with and guide their students. Further, research in counseling consistently reflects some level of school counselor bias (Kane, 1991). This bias may greatly impact the career and major choice of female students going into engineering and other STEM fields, which are often considered nontraditional careers for females (Kane, 1991). This potential bias does not only hurt and limit career opportunities for female students, but can also be detrimental to male students who seek nontraditional (e.g., female-dominated) careers (Rodano, 2005). Further, these biases have a disadvantageous effect on our society as a whole, as gender bias that keep motivated, intelligent and deserving students out of potential careers ultimately hurts communities, professions, and the country as a whole (Holcomb-McCoy, 2007). Given that school counselors influence student decisions and outcome and biases exist in the behavior and attitudes of school counselors, it seems prudent to understand the nature of this bias as it relates to consideration of engineering careers among students.

It is for this reason that a survey was developed and distributed to school counselors during their annual conference on June 16-17, 2011 at Murray High School, Salt Lake City, Utah. The survey was designed to better understanding of the accuracy of knowledge school counselors have about engineering. Further, we hope that results from this survey will shed light on the potential gender bias that may exist about female participation in a nontraditional field such as engineering.

Instruments

Based on the observations offered above, we developed a survey in order to explore school counselors’ knowledge of engineering as a career and the values they associate with those who chose engineering as a field. Survey research was deemed the most appropriate methodology for this aspect of the project for a number of reasons. First, surveys allow for data collection from a large number of respondents. Second, they can be used to study values, beliefs and past behavior; third, they are easily administered; and lastly, they are specific in nature and can be geared towards the attainment of specific information appropriate to the research (Shaughnessy, Zechmeister, & Zechmeister, 2006).

Survey items were developed to specifically assess two areas. The first was the knowledge counselors have about engineering. This aspect of the survey included questions regarding achievement in engineering (based on ACT math scores), degree required to work in the field and questions about the gender demographics in the field itself. These questions aimed to illuminate the validity of the knowledge base counselors were using in their work with students. The second aspect of the survey investigated the attributes and values counselors associated with those who chose engineering as a field. The purpose of these questions was two-fold: to provide insight into how counselors viewed those who were interested in or employed in engineering fields, and to establish whether or not these answers changed based on the gender of the student. The goal of these questions was to illuminate potential differences in the ways counselors view male versus female students who report interest in engineering. We were also interested in whether or not these attitudes translated into their work with students of differing genders.

Once survey construction was complete, the survey underwent pilot testing. Pilot testing of the survey protocol was performed before final data collection in order to: (1) confirm the clarity of the questions; (2) make sure the survey did not contain unwarranted assumptions; (3) eliminate “double-barreled” questions (questions that asked about more than one issue at a time); and (4) choose the most appropriate response format for each question (Leary, 2001). For this study, a pilot survey was tested on school counseling students at the University of Utah. Students were contacted via email, and participants were asked to complete and provide feedback about the survey. Although only 17 respondents provided feedback, some changes in wording and format were made. This feedback was incorporated into the final version of the survey. (A copy of the final survey is provided at the end of this chapter.)

Data for quantitative analysis was collected in the form of self-report surveys administered to participants on the day they were recruited to participate in the study. The following section describes the measure used.

The first part of the survey includes questions specific to counselor’s knowledge about engineering, such as the type of degree a person needs to work in a specific engineering field or what salary an average engineer makes. Questions were also focused on the counselors’ knowledge of the gender disparity in the engineering field as well as on engineering subspecialties.

The second section of the survey was used to assess the values that school counselors associate with those who choose engineering as a major or career. These questions specifically aimed to understand what qualities school counselors believe an engineer possesses, and what qualities they believe would not fit well with participation in an engineering field.

The survey was designed to better understand the knowledge that school counselors have about engineering, as well as what values and personality characteristics they may associate with engineers. This data was collected first through fill-in-the-blank questions as well as open-ended survey questions.

Participants

Participants for this study were members of the Utah School Counselors Association (USCA), which is comprised of school counselors across the State of Utah. Over 115 participants were recruited, all of whom were school counselors and members of USCA. Total attendance at this conference was approximately 400 people. Because participants were recruited at random from the USCA conference population, it was assumed that participants' demographics reflected those of school counselors who attended the conference. Further, because this conference draws from counselors across the state of Utah, it was also likely the demographics and opinions of the counselors reflected those of counselors across the state of Utah. However, it should be noted that no specific demographic information was obtained from the participants. Specifically, we did not want demographic information or any means of identification (school district, gender, religion) to affect the participants' responses.

Participants were recruited at the Utah School Counselors' annual conference on June 16-17, 2011, at Murray High School in Salt Lake City, Utah. A table was set up next to the registration table and participants were asked to complete the survey. On the second day of data collection, more participants were recruited through an announcement made during the morning meeting in the conference auditorium. All school counselors registered in the conference were deemed acceptable participants, as all participants were currently employed school counselors in the state of Utah.

Each participant was informed that the survey was geared towards better understanding of school counselors' knowledge and values regarding engineers and engineering as a career/major. Participants were informed that completing the survey would take 10-15 minutes. It was emphasized to each participant that all information would be kept confidential and anonymous and there would be no record kept of which individual completed which survey. Prospective participants were also informed of an incentive to participate, which consisted of being entered into a raffle to win a $100 gift card to Amazon.com. Participants were first asked to complete the survey. Once the survey was completed, their results were quickly checked to confirm that all answers were completed and each set of directions had been followed. Once this was established, participants wrote their names and email addresses or phone numbers on pieces of paper, which were then placed into a fish bowl on the table. The winner was selected at the end of the second day and was notified by telephone.

Procedure

Research questions for this study were based on the knowledge that there is a substantial gender disparity in engineering fields and on the fact that school counselors may influence students' educational and career decisions related to engineering and other STEM fields. Two primary research questions were asked in order to better understand the relationship between the school counselor and student choice. The first question was: how accurate is school counselors' knowledge about engineering-related fields? This question was answered through qualitative data analysis regarding the accuracy of their survey answers. The second research question was: do school counselors' beliefs about the desirable personality characteristics, values and attitudes of potential engineers differ by students' gender? This question was answered through qualitative analysis of open-ended and rank order questions in the survey. This study utilized a mixed-methods analysis approach to data in order to understand the effects of school counselors' knowledge and values about engineering on the gender disparity in engineering fields. The following are the research questions and their associated hypotheses:

1) How accurate is school counselors' knowledge about engineering-related fields?

Hypothesis: School counselors will demonstrate a lack of knowledge with regard to entrance requirements for college programs in engineering, degree requirements, and gender representation in engineering and engineering subspecialties.

2) Do school counselors' beliefs about the desirable personality characteristics, values and attitudes of potential engineers differ by students' gender?

Hypothesis: Counselors' beliefs about the personality characteristics, values and attitudes that are desirable in an engineer will differ based on gender. Further, it is likely that the counselors' beliefs about desirable attributes may display gender bias and demonstrate a favoring of traditional gender roles and careers over nontraditional gender roles and careers.

This study used Creswell, Clark, Gutmann, and Hanson's concurrent triangulation research design method (2003). This design equally weighs both qualitative and quantitative data. Both types of data are collected simultaneously, but analysis of the data occurs separately and integration of the two types of data occurs postanalysis. The integration of the collected data for interpretation provided confirmation or disconfirmation of expected outcomes. Integration of the data also allowed for observations to be extrapolated from the data.

The quantitative component of the study design was approached through the use of simple descriptive statistics. Each participant's survey data was analyzed to ensure correctness and to determine frequency of responses, and the median was computed. This data was derived from the "fill-in-the-blank" and the "rank order" questions. Because this type of research does not manipulate variables, causality cannot be derived from these findings (Gelso & Fretz, 2001); however, inferences can be made that can aid in gaining a better understanding of gender bias in school counselors and how this may lead to the gender disparity in engineering-related fields and to inform future research.

The qualitative component of the study design was approached using methods of interpretation via document analysis (Erickson, 1986). The purpose of interpretative analysis is to give meaning to self-report answers. To this end, themes were established through coding of the data collected through the open-ended survey questions. These questions led to an understanding of those who held these meanings and perspectives, and allowed me, the researcher, to gain awareness of areas that have not yet been explicitly articulated (Erickson, 1986). More detailed description of how quantitative and qualitative data was extracted and analyzed is included in the following subsections.

Quantitative descriptive statistical analysis procedure. Analyzing quantitative data involves the use of statistics to describe, summarize and compare the data. Survey data analysis was conducted using SPSS software from IBM (SPSS. com, 2010). Analysis procedures involved the calculation of descriptive statistics, including frequency, percentages, and measurement of central tendency. While the mean and variance calculation helped highlight the focus and consistency of the counselors' beliefs, correlational analyses emphasized the dominant factors in counselors' beliefs and how these variables related to each other.

Qualitative content analysis procedure. The first step in the qualitative study was to perform content analysis. Content analysis was performed in order to better understand the meaning of the provided answers. In order to do this, the contextual information was first converted into a more relevant, manageable data set (Berelson, 1952; Rosengren, 1981; Weber, 1990). The central goal in content analysis is to classify words, phrases or other units of text into a limited number of meaningful categories that are relevant to the study's hypothesis.

First, I must decide what units of the survey will be analyzed. For this study data analysis was conducted in the form of words and phrases written by participants. From there, the words and phrases were converted into themes or "utterances" (Erickson, 1986). The text was then examined to establish all the distinct themes (Stiles, 1978). I then established how the units of texts were coded. For the purpose of answering the aforementioned research questions, data was coded through classification. This entails each unit being categorized into one of several, exclusive categories. The responses of participants fit well into predetermined groups based on their themes, and through analysis the finalized themes were determined. Of the 115 surveys collected, 12 of the surveys obtained were deemed inappropriate due to lack of proper formatting or incomplete information, and were therefore not used in the final data analysis.

Results

Quantitative results. School counselors had a moderately accurate understanding of the educational and achievement requires for entering a college engineering program. For example, when asked what the average math ACT score was to be admitted into an engineering major at the University of Utah, approximately 56% of respondents were correct in the knowledge that a score of between 26 and 28 was required. This, however, means that 44% of respondents either had an estimation that was too high (18%) or too low (28%). When asked what the minimum score might be to gain admittance into an engineering program, interestingly, counselors seemed to think admissions standards were much more rigorous than they might actually be, as approximately 42% of respondents believed that the minimum qualifying score was above 25. School counseling participants do appear to have a relatively accurate understanding of the actual gender distribution of incumbent engineers, as the average percent reported by counselors was 80.1% male, 19.9 % female. Lastly, when asked the degree requirement to work as an engineer, 78% of respondents accurately endorsed a bachelor's degree. However, 17 % believed a master's degree was necessary to work in the field.

Qualitative results. The first qualitative question counselors were asked on the survey was why they believed only 15% of engineering students at the University of Utah were women (see Figure 4.1). Interestingly, the most predominant answer was that it was a male-dominated field. It seems this perception of the field is likely a contributing factor in the underrepresentation of women in engineering fields, as the more male-dominated the field is, the less likely a female will be to enter the field. The second-highest response from the counselors was that female students were not interested in the field. This belief may impact counselor assumptions that female students are inherently not interested in the field, and they may therefore be less likely to give female students information (third-highest answer) or encouragement (fourth-highest answer). Even though having a family was the fifth-highest answer provided by school counselors, it still retained a relatively high number of endorsements, given the open-ended format of the question.

When asked why they believed a qualified student would choose engineering (see Figure 4.2), six themes arose regarding male and female students. School counselors believed that male students would choose the profession because of the earning potential, job security and their interests. Having opportunities for growth, encouragement to go into the field and flexibility also came up for male students. Interestingly, school counselors' list of reasons why female students would choose engineering were very similar, although lower in overall frequency. Once again, money, job security and interest were the most predominant factors, though flexibility was also much higher for responses regarding female students than male students. It should be noted that opportunity and encouragement, though very high as a perceived contributing factor for male students, barely registered for female students.

The third question asked school counselors to list the top three reasons why a qualified student would NOT choose engineering (see Figure 4.3). Open-ended formatting was again used for this question. The responses were coded into six predominant themes that appeared in the counselors' responses. These themes were relatively consistent across both responses for male and female students and included: because the student was 1) not encouraged, 2) not interested, 3) lacked information, 4) was not smart enough, 5) wanted a family and 6) believed the field was too male-dominated. The most highly endorsed answer regarding male students was the perception that they did not have enough information about the field. Second was the perception that engineering was a predominantly male field. This indicates that the cycle of male domination in this field may be affecting the recruitment of both genders. Third was the student’s lack of ability in the areas of math and science. Similar themes appeared with respect to female students, although the distribution of the counselors’ answers was somewhat different. Similar to how the question was answered for male students, the most predominant reason a school counselor believed a female student would not choose engineering was due to lack of information. Interestingly, the fact that engineering was a male-dominated field was the second most frequent response of school counselors in this study. The third highest response was the belief that female students are not encouraged to go into the field, which was followed closely by the belief that female students would be interested in having a family – a response not prevalent when counselors attributed reasons for qualified males not entering the field. For this response we received answers such as “engineering isn’t conducive to being a mom” and that it is “not a woman’s job.” It should be noted that not once in all of the 103 surveys did gender roles or family responsibility come up as a response for why male students would not choose engineering. Interestingly, for males, family responsibility and traditional gender roles were often seen as a reason to become an engineer (due to earning potential and job security). For males it seems that traditional gender roles and occupations may be reinforced by the pre-existing gender roles and occupational imbalances. Lastly, school counselors indicated that female students may not go into the field due to lack of ability, even though this question specified that the student was “qualified.”

Counselors were also asked what factors would cause them to steer male or female students away from majoring in engineering (Figure 4.4). This question was aimed at gaining a better understanding of what might actually happen in a counseling session with a student that could influence a counselor to discourage a student from entering this field. Many counselors responded that they would not discourage a student from going into a field; however, other counselors had reasons that they would. Once again these answers were coded and grouped into themes. For male students these themes included lack of interest, lack of ability (difficulty in math), being unmotivated, having negative stereotypes about engineering and not being able to afford school. For female students themes were similar, although once again, the theme of the field being male-dominant and not congruent with traditional gender roles came up as reasons a school counselor would *discourage* a student from going into the field

The counselors were asked to rank order what they believed to be the top three core values of a male or female engineer (Figure 4.5). Five themes were given to choose from. This question aimed to illuminate the counselor’s views of personality characteristics and motivations of those who chose engineering as a career. The most predominant theme for both genders was being hard-working, followed by being perceived as career-oriented, wanting to help the world, being people-oriented and finally, being family-oriented. Though most of the responses were comparable between the genders, being hard-working and career-oriented were higher for males than females and desire to help the world, being people-oriented and being family-oriented were all higher for females than males.

The counselors were also asked what they believed to be the top three characteristics a male or female engineer may feel his or her job offers. This question asked participants to rank order their responses on a scale of 1to 3 when given 11 themes. This question aimed to clarify what counselors believed were the motivating factors for choosing a career in engineering. These themes included the ability to do research, the potential to grow in the field, job security and flexibility. Overwhelmingly the response of wanting to "change the world" often came up for females, though very rarely for males, and was one of the only responses that garnered more responses for females than males (Figure 4.6)

Conclusion

As female participation in engineering fields has continued to be disproportionately low, the necessity for interventions is apparent. Recent data suggests that female interest in engineering is on the decline from a peak in 2000. Approximately 17% of females express interest in engineering majors (Di Fabio, 2008). Similar gender disparities are seen at the occupational level (U.S. Department of Labor, 2008). Perhaps even more disconcerting is the disproportionately low representation of females in these fields. Similar gender disparities are seen at the occupational level (U.S. Department of Labor, 2008). An example of the gender disparity in engineering can be seen through historical data of the number of female freshmen with the intent to major in engineering (Iskander, Gore, Furse, & Bergerson, 2011). In 1982, only 16% of women expressed interest in the major, and this percentage dropped to 14% in 1989 and continued at this level until 1998 (Babco, 2000). This is disquieting given the significant efforts by government agencies, private organizations and foundations to increase gender diversity in this area. The gender disparities observed in this profession persist despite efforts to promote increased participation (National Science Foundation, 2007). The purpose of this portion of the dissertation research was to better understand Utah school counselors' knowledge about engineering and the values they associate with those who chose to pursue this field.

Results demonstrate that school counselors have accurate knowledge about the gender disparity in engineering-related fields, and have a moderately accurate understanding of the educational and achievement requirements for entering a college engineering program. However, counselors also demonstrated significant differences in their open-ended responses based on gender. The comparison between the responses based on student gender indicates that there are more societal components influencing counselors' responses for female students. It seems that when a counselor responds about a male student, he or she looks at the student’s abilities (grades) and his interest level. While this may also be true for female students, it seems that conflicting gender stereotypes and a female's potential familial obligations also influence counselors' responses. It seemed that counselors viewed female engineers as seeking a non-traditional path that afforded them more flexibility, while males were more interested in prestige and financial gain. Encouragement and the chance to change the world were much more likely to be seen as motivating factors for females than for males.

Counseling with females was more likely to be affected by negative stereotypes and the gender disparity in the field, while counseling with males was more affected by factors such as lack of motivation, lack of interest and difficulty in math. Family, gender roles, familial obligations and social personalities were all reasons why a counselor would *discourage* a female from going into engineering, which rarely occurred with male students. This may indicate the presence of a bias in counselors' perception that being an engineer is not congruent with other values such as starting and raising a family. This perception is also likely to impact how counselors interact with female students and their recommendations, especially in nontraditional careers. Further, these questions seem to demonstrate that counselors may have an active part in perpetuating stereotypes about the engineering fields, and may be actually discouraging qualified students (particularly female students) from the field due to these stereotypes.

These preliminary results warrant further investigation into the attitudes and values counselors associate with engineering-related fields. Further, looking at the way these attitudes influence how school counselors may view students, and in turn, how appropriately they guide students into certain careers may be an important factor. By increasing insight into how counselors may account for gender, interventions into ameliorating the gender disparity could be utilized in a more directive and targeted manner.

Survey

Please fill in your response in the area provided below the question.

1) What do you believe is the average ACT score for admission directly into University of Utah engineering programs?

2) What do you believe is the minimum average ACT score for admission directly into a community college engineering program?

3) What percent of working engineers today do you believe are male?

4) What percent of working engineers today do you believe are female?

5) Which colleges in your state have engineering programs? Please list.

6) What do you believe is the degree requirement to work as engineer? (High school, Bachelor's degree, Master's degree, Ph.D., Post-Doctorate)

For the next set of questions, when the word QUALIFIED is used, it indicates a student who will graduate from high school having taken at least pre-calculus, or probably calculus if it is offered. A qualified student has also scored at least a 26 on the math section of the ACT.

Check (and prioritize from 1 to 3) the top three attributes for male and females for each of the following questions. Please answer individually for male and females, though your responses may overlap.

1) What do you believe to be the core values of **(M/F)** engineers?

For Females	**For Males**
___Career-Oriented	___Career-Oriented
___Hard-Working	___Hard-Working
___People-Oriented	___People-Oriented
___Desire to help the World	___Desire to help
the World	
___Family-Oriented	___Family-Oriented

Figure 4.1

Utah School Counselor Survey

2) Characteristics **(M/F)** of what an engineer may feel his/her job offers:

For Females	**For Males**
___Job flexibility	___Job Flexibility
___Job security	___Job security
___Potential to grow in field	___Potential to grow in field
___Potential to be a manager	___Potential to be a manager
___Ability to work with others	___Ability to work with others
___Ability to run a company	___Ability to run company
___Ability to research interesting things	___Ability to research interesting things
___Potential to work alone	___Potential to work alone
___Potential to travel	___Potential to travel
___Potential to change the world	___Potential to change the world
___Potential to help people	___Potential to help people

3) Why do you think approximately only 15% percent of undergraduate engineering students at the U of U are women?

4) Please list the top three reasons you think a qualified **Male** student would chose engineering as a college major.

5) Please list the top three reasons you think a qualified **Female** student would chose engineering as a college major.

6) Please list the top three reasons a qualified **Male** student would NOT choose engineering as a college major.

7) Please list the top three reasons a qualified **Female** student would NOT choose engineering as a college major.

8) What are interests (or lack of) that would cause you to steer a **Male** student away from majoring engineering?

9) What are interests (or lack of) that would cause you to steer a **Female** student away from majoring in engineering?

Figure 4.1 Continued

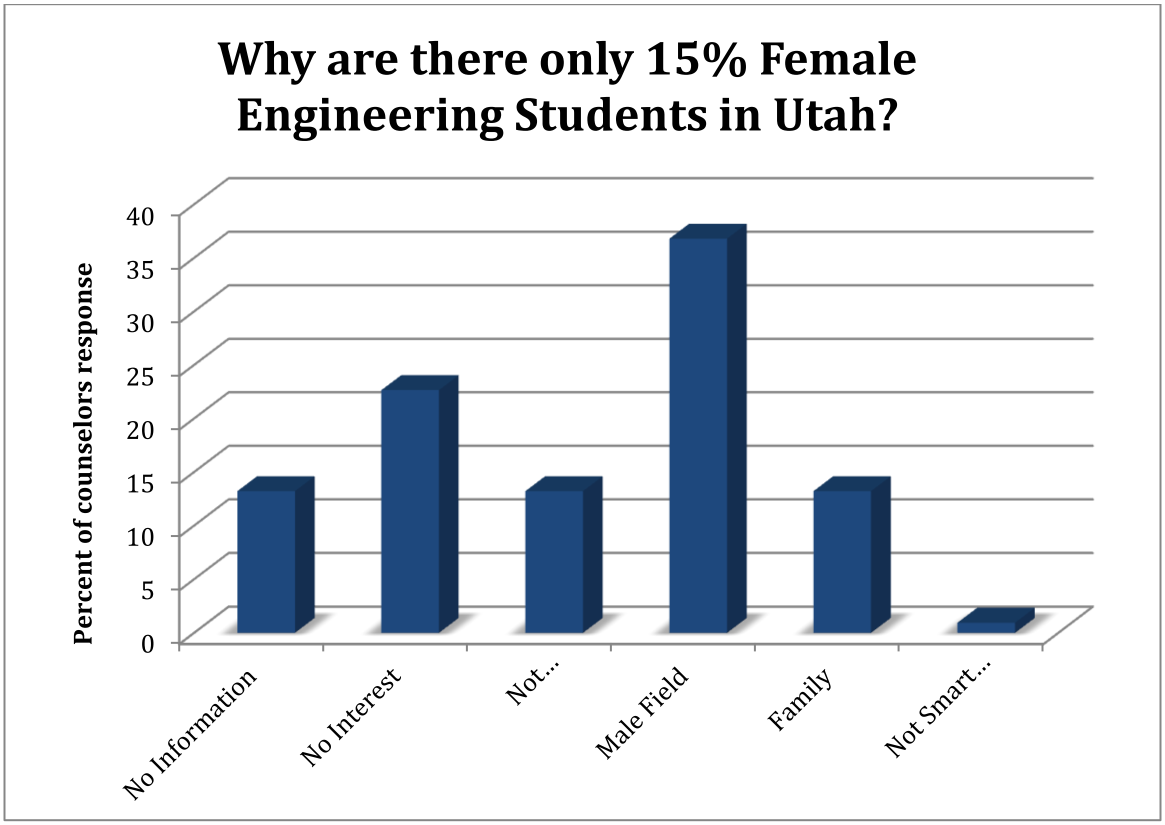

Figure 4.2

Why are there only 15 % female engineering students in Utah?

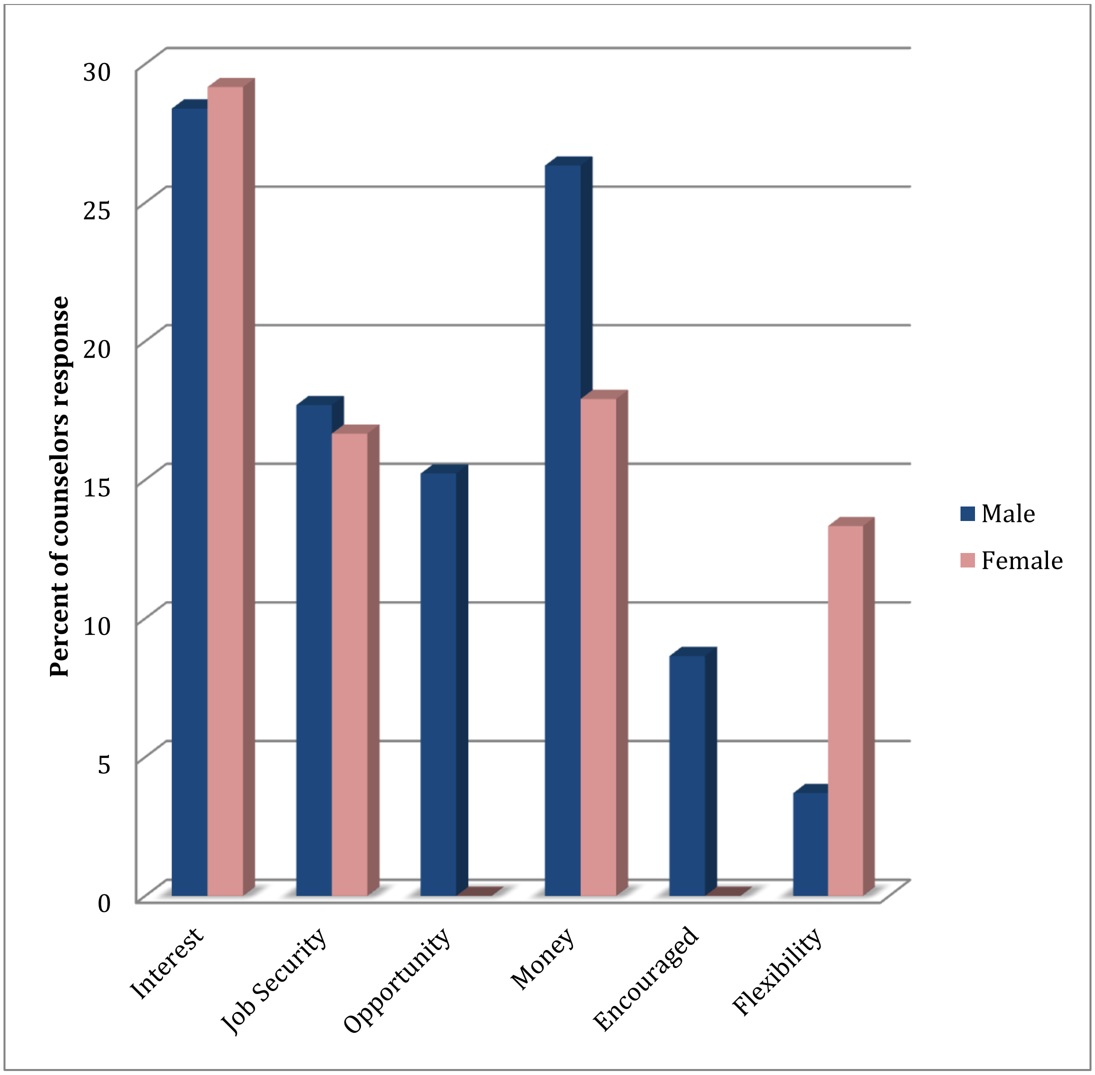

Figure 4.3

What are the top three reasons you think a qualified male or female would choose engineering?

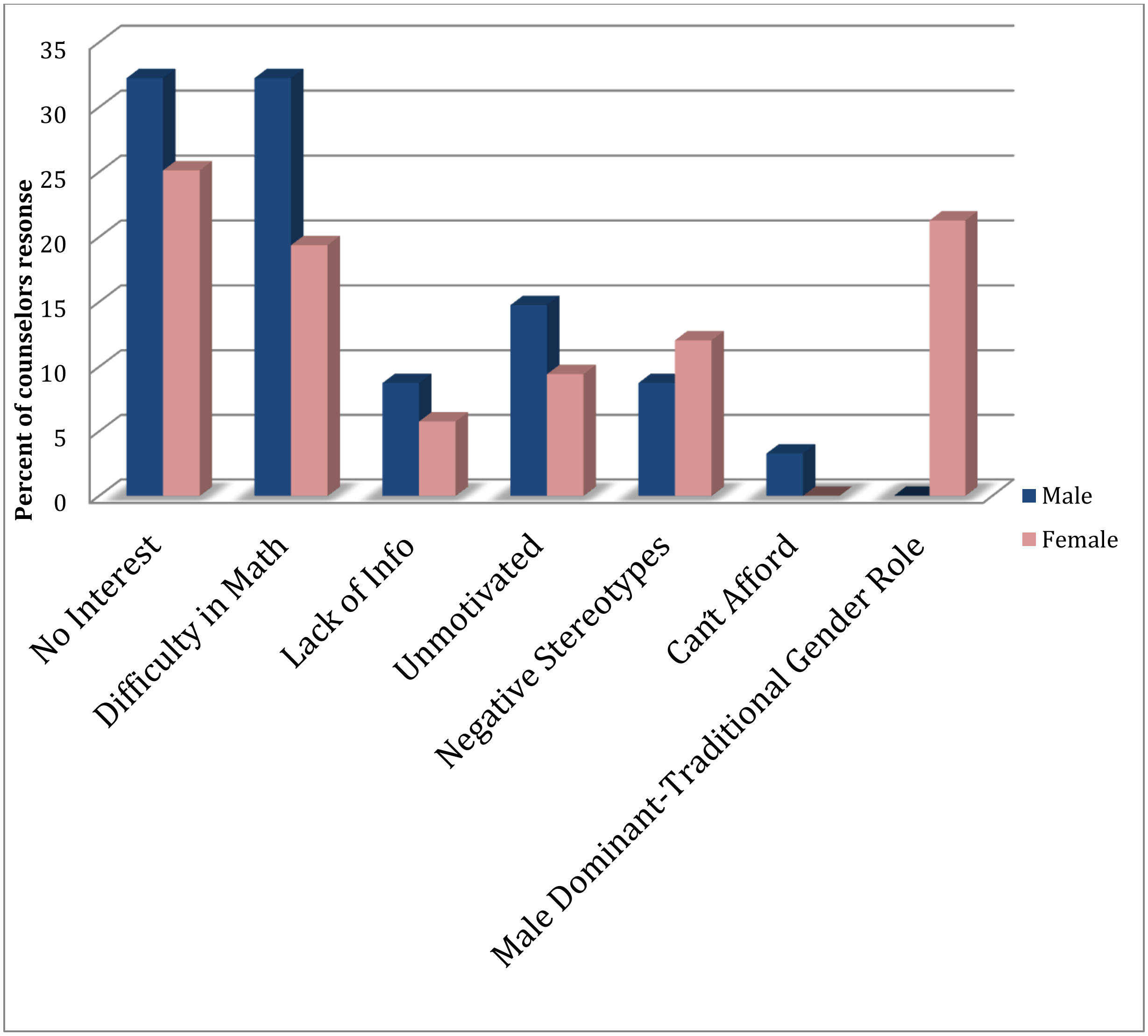

Figure 4.5

What are the top three reasons a qualified male or female would NOT choose engineering?

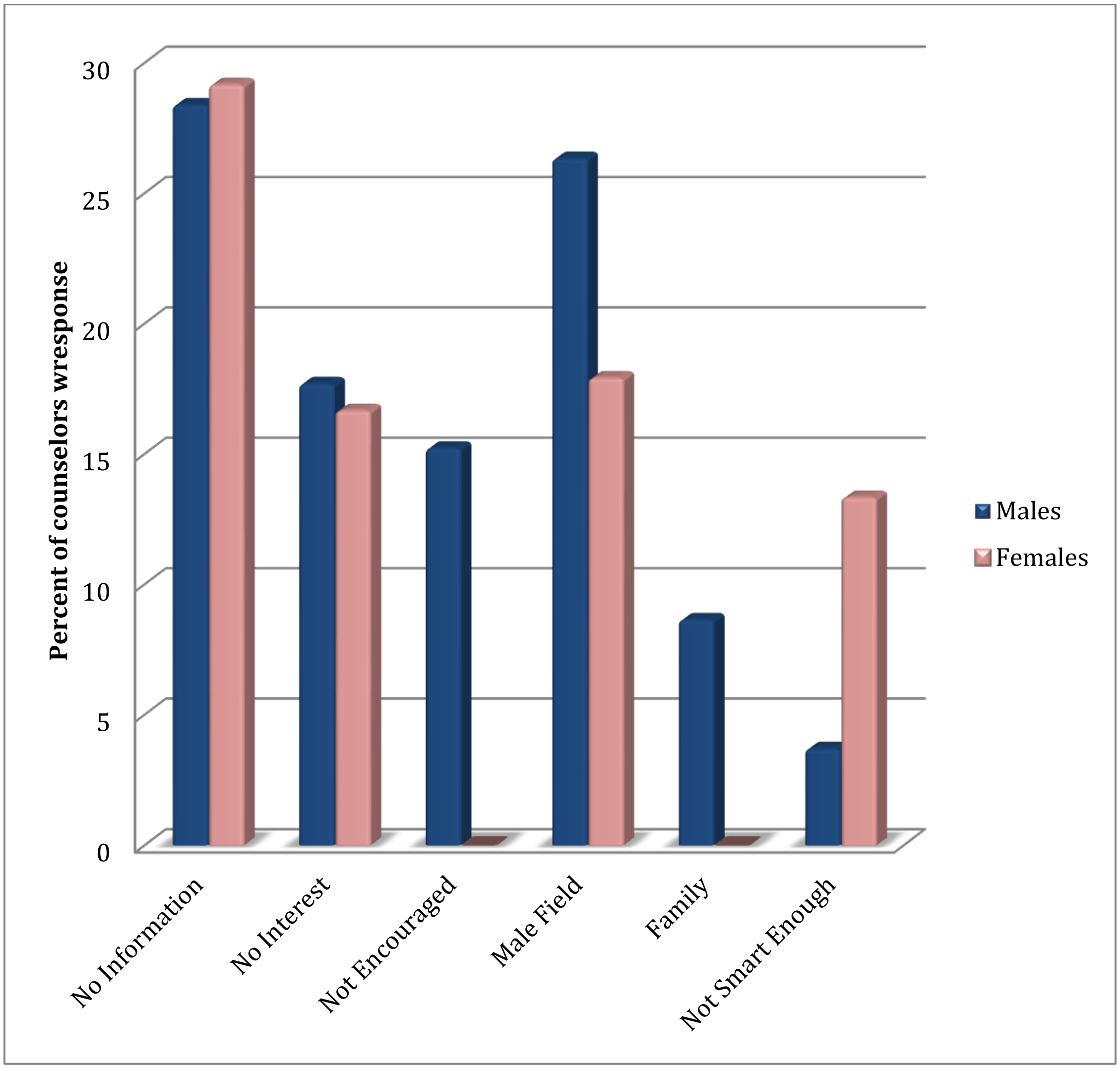

Figure 4.6

What interests (or lack of) would cause you to steer a male or female student away from majoring in engineering?

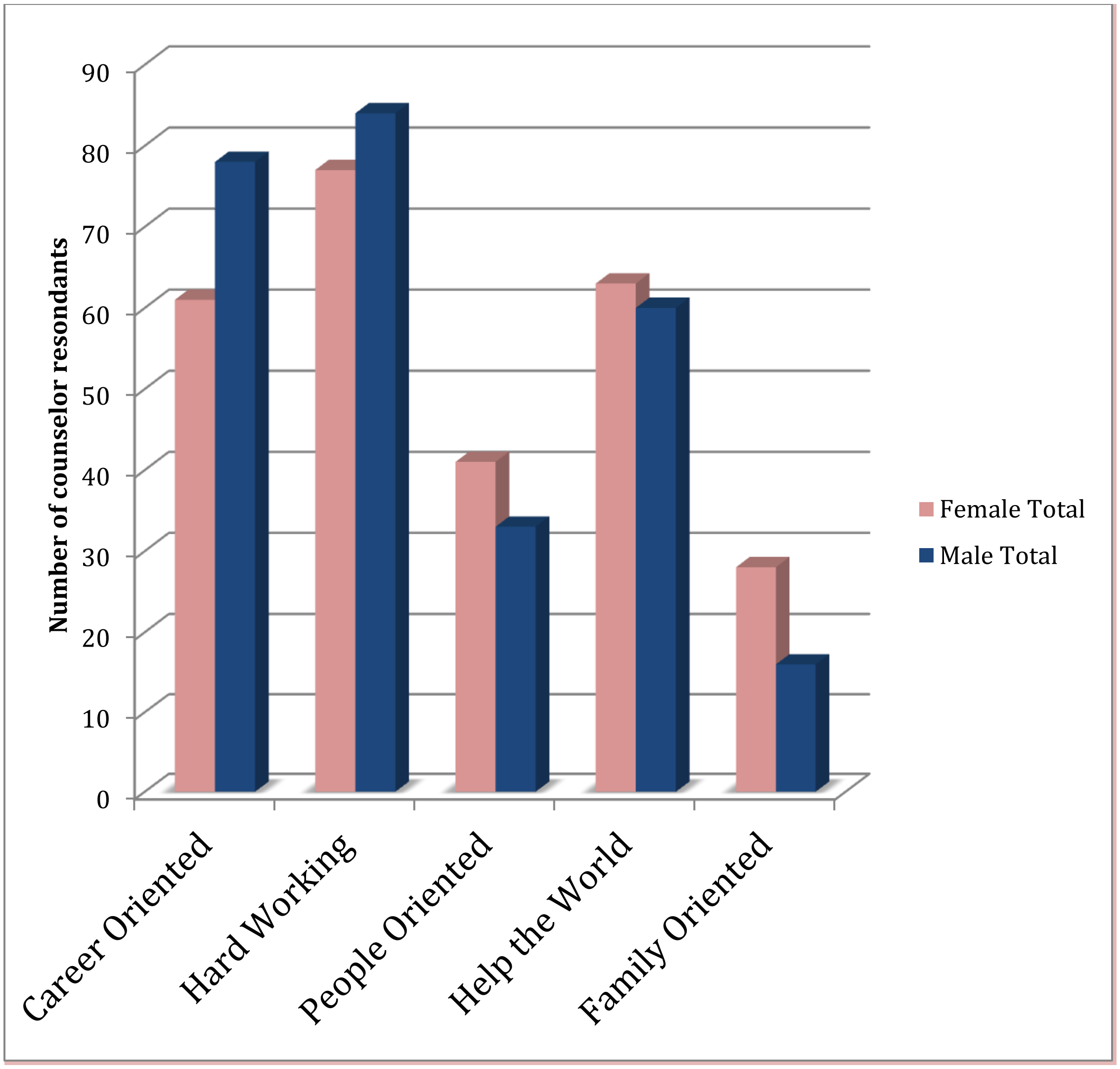

Figure 4.7

What do you believe to be the core values of a male or female engineer?

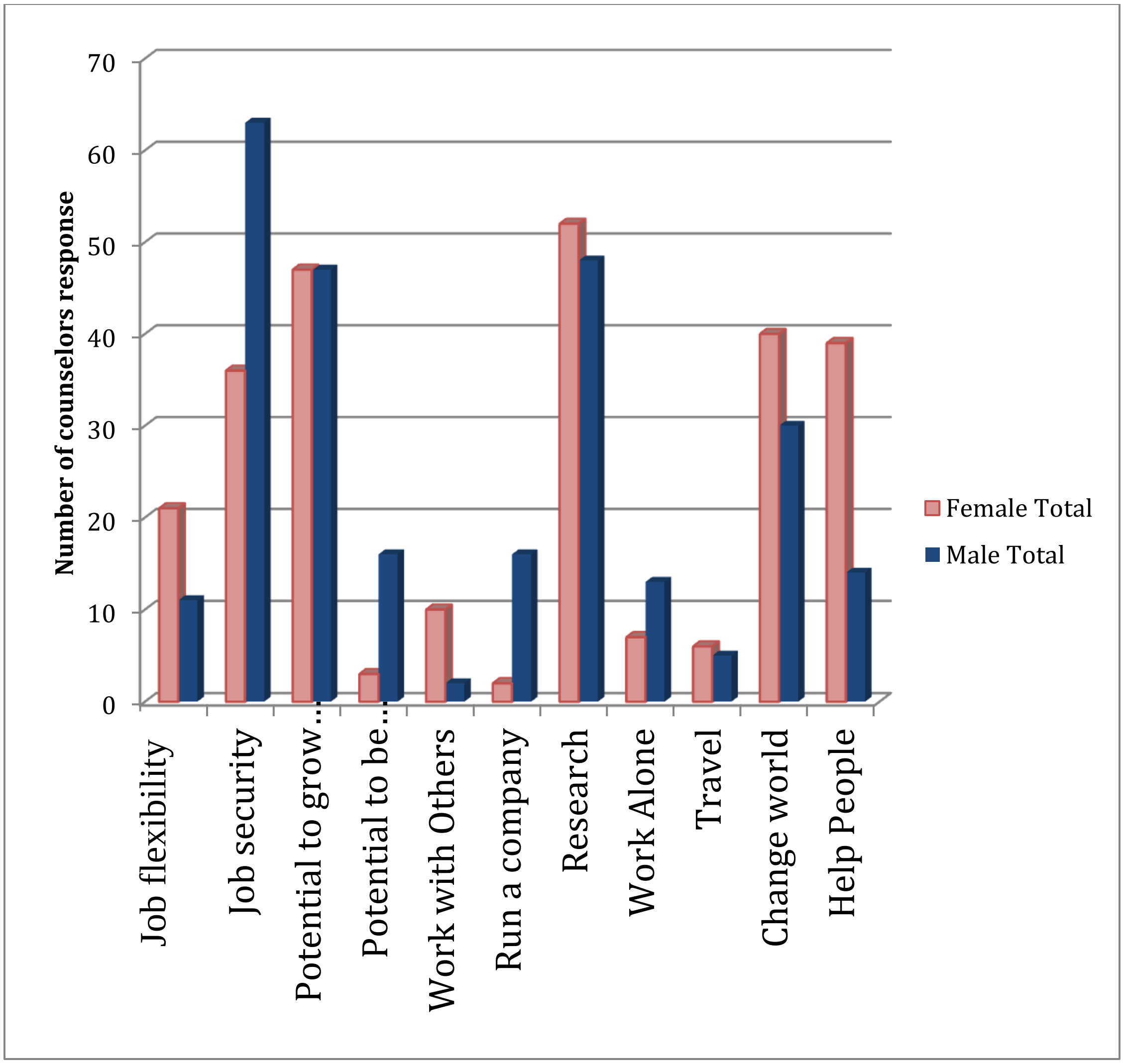

Figure 4.8

What are the top three characteristics a male or female engineer may feel his/her job offers?

CHAPTER 5

NATIONAL VIGNETTE STUDY

Literature Review

Results from the previous study suggest that school counselors’ attitudes and beliefs related to engineering careers are partially moderated by student gender. As such, this study aims to further examine the gender bias that may be present in school counselors’ attitudes towards students' educational and career decisions. Research has established that factors such as gender and socioeconomic status have an effect on school counselors' attitudes about students, in that perceived stereotypes about students may cause counselors to guide students differently (Auwarter & Aruguete, 2008). Research also suggests that stereotypical and biased attitudes are prevalent in the work school counselors do with students (Kane, 1991). It is possible that these attitudes influence the career and major choice of female students by discouraging them from pursuing engineering and other STEM fields or taking courses that would enable them to pursue these fields later. Research is needed to explore the potential biases and attitudes that exist in practicing school counselors before launching studies that relate those biases to actual student behavior. Because vignettes have been established as a reliable form of research for gaining information about attitudes, especially in sensitive topical areas, this methodology was selected for this research project. Specifically, part three of this study is designed to better understand school counselors' attitudes related to math and science coursework and careers for male and female students in STEM and engineering fields. We employed a vignette design that crossed factors (student gender, school counselor gender and student personality attributes) while holding the variables of *engineering-congruent interests* and *high past math performance* constant (two characteristics that would suggest STEM field pursuit). This allows for inference that any difference in result is due to the gender difference or personality attributes. An effective vignette design will help explore counselors' beliefs about (a) possible academic paths and (b) possible postsecondary education.

Vignettes were perhaps first seen in qualitative and quantitative research of social judgments in Piaget's work (1932, 1965), when he used "story situations" to investigate moral reasoning in children. Vignettes have continued to be a useful methodology in the social sciences as a way to uncover people's assumptions, beliefs and bias about a myriad of topics (Hughes & Huby, 2002). Despite the fact that vignette methodology has not yet been applied to school counseling research, it is widely used in other disciplines such as anthropology, nursing, social work, professional ethics, and psychotherapeutic decision-making (Hughes & Huby, 2002). It differs somewhat from standard survey research in that clinically relevant context is provided in the form of a short vignette and participants are asked to indicate their preferred course of action. The use of vignettes permits an investigator to gather large amounts of data that may not otherwise be available, or if available, would require a larger number of participants (Piaget, 1932; 1965). We believe this methodology represents a viable means for beginning to investigate school counselors' attitudes and behaviors towards male and female students with respect to math, science, and engineering-related educational and career opportunities, and has the potential to reveal subtle biases that may not be revealed using more overt survey methods (Brondani, MacEntee, Bryant & O'Neill, 2008).

Vignettes are brief stories or scenarios that describe hypothetical people and/or situations, to which a participant is asked to respond. Because the situations are hypothetical, they offer a less threatening way to explore sensitive subjects (Finch, 1987) while still allowing for specific contextual influence on judgment to be examined. Vignette methodology offers a number of benefits, mainly in the ability to elicit data related to potentially delicate topics about participants' awareness and attitudes. Vignettes offer flexibility that allows the researcher to design his or her own instrument in order to focus on specific topical interests, while still projecting an air of impersonality in the participants that encourages them to think beyond their own circumstances, an important feature for sensitive topics (Schoenberg & Ravdal, 2000). There is evidence that vignettes offer a way of determining the cognitive processes utilized in a participant's decision-making process. Further, vignette research can help to illuminate elements of a situation important in this decision-making process (Morrison, Stettler, & Anderson, 2004).

Vignettes have been shown to address complex issues effectively and economically, allowing for the participation of a large number of respondents, thus mirroring the efficiency of quantitative methods while also offering the detail-oriented understanding synonymous with qualitative research (Finch, 1987). The contextualized scenarios presented in vignettes are familiar and concrete, allowing the participant to easily place him or herself into the situation, and reflect upon how he or she would respond (Morrison, Stettler, & Anderson, 2004; Schoenberg & Ravdal, 2000). Because of their familiar nature, vignettes are often seen as "less threatening" than other forms of research, and therefore give the participant more permission to respond truthfully (Barter & Renold, 2000; Schoenberg & Ravdal, 1999).

Though used in both qualitative and quantitative research, the methodology for each vignette study can be markedly different. Often qualitative researchers are more concerned with preserving the reality of the situation, and may create vignettes based on actual situations reported to them. The vignette is then used as a stimulus to open-ended discussions with respondents in order to explore their reasoning and judgments. Quantitative researchers, on the other hand, are more focused on constructing vignettes that allow for systematic manipulating of features within different vignettes. These factors are then evaluated based on how each factor seems to affect the participants' choices and judgment. Respondents in quantitative or qualitative studies may be asked to rank, rate or sort vignettes into categories, or to imagine what a vignette character would or should do or feel or how they would react in the vignette scenario. Due to the randomization of the factors within the vignettes, as well as the randomization of the selection of vignettes for each participant, this type of factorial survey offers the unique capability to investigate the effect of multiple factors in complex decisions (Taylor, 2006).

The following subsections describe the method for vignette construction, participant recruitment, and data analysis methods.

Instruments

The vignettes were developed using established formats from classic moral dilemmas by Kohlberg (1976), and other examples found in the literature. These alternate formats include: the Social Work Values Inventory (Pike, 1996), which provides brief scenarios, requiring respondents to indicate the action they would take based on anchoring statements; and the Moral Justification Scale (Gump, et al., 2000), with extended vignettes and embedded statements that reflect caring and/or justice responses. Respondents are asked to rate the statements taken directly from the vignette on a scale of 1 to 10, basing judgments on the importance of the statement in making a decision about the dilemma.

Further, vignettes were constructed based on Barter and Renold's guidelines for vignette research (1999). These include: 1) Vignettes should appear plausible and real in order to engage participants; 2) vignettes should focus on mundane rather than bizarre events or characters; 3) vignettes should contain a balance of sufficient content for participants to understand the situation but be ambiguous enough to "force" them to provide additional factors which influence their approach; and 4) vignettes must avoid unnecessary changes to a storyline, as they can be confusing to participants.

In study number two (Chapter 4) we established a differences between counselors' reported beliefs in regards to how appropriate engineering was for male and female students. In this study we found that counselors seemed to believe that "non-conformist" female students were more likely to be interested and/or qualified to enter engineering-related fields than female students who possessed interest in "helping people." Given this information, we chose to further explore the impact of personality attributes on school counselors' attitudes about the appropriateness of certain high school courses and college majors.

Four vignettes were constructed for this research. Each participant was randomly assigned to one of the four vignettes. The four vignettes were labeled Jane 1, Jane 2, John 1, and John 2. Each vignette described a student taking the same math and science classes, expressing interest in these subjects, being successful in his/her coursework and enjoying his/her classes. The four vignettes differed in two ways: gender and personality attributes of the student. Two of the vignettes were male and two were female. Of these two, one of each gender was described as “bright, outgoing, socially engaged and involved in student activities” and “express[ing] a strong desire to help others” (Jane/John 1) while the other was described as “bright, outgoing, and a non-conformist” and “express[ing] a strong desire to pursue a career in an environment in which achievement is highly valued and where she/he will receive recognition for her/his hard work” (Jane/John 2).

The content validity of the vignettes was tested through a pilot study of University of Utah school counseling students. These participants were asked to complete the vignette, as well as to provide feedback about the understandability and readability of the vignette and questions. Analysis indicated there was no issue in the understandability or construction of the vignette. Further, the students indicated the vignette was easy to understand and the link that was used to distribute it was described as user-friendly. Because of this feedback no further changes were made to the vignette before it was distributed nationally.

Participants

Participants for this study were recruited through web-based listserves used by state school counselor organizations. Participants were recruited through contact with the president of the specific state organization. We were accepted on four listserves nationwide (New York, Georgia, Washington State, and Indiana). Vignettes were then web-delivered to members of the listserv in these states. Participants were informed that the vignette would take 5-10 minutes to complete. It was important to emphasize to each participant that all information would be kept confidential and anonymous and that there was no record kept of participant information. Prospective participants were also informed of an incentive to participate, which consisted of being entered into a raffle to win a $100 gift cards to Amazon.com. The winners were drawn after data collection was completed.

A total of 185 participants completed the four vignettes, with an approximately equal number completing each of the four scenarios. Of these participants, approximately 159 were female and 26 were male, ranging from 24 to 66 years of age, with a mean age of 42. All were currently employed as school counselors. The participants' level of experience was as follows: 1-5 years, 37.7%; 5-10 years, 22.3%; 10-15 years, 16.4%; 15-20 years, 10.9%; and 20+ years, 12.7%. Similarly, the number of years since they had received their school counseling degree was very similar to their years of employment: 1-5 years, 35.9%; 5-10 years, 20.9%; 10-15 years, 15%; 15-20 years, 12.3%; and 20+ years, 15.9%. Of these participants, approximately 30% reported currently working in an elementary setting, 15% reported currently working in a middle school setting and 55% reported currently working in a high school setting. Approximately 67.6% of respondents believed the graduation rate of their school was between 75 and 100%, while 26.1 % believed it was 50-75%, 3.6 % responded it was 25-50% and 2.7 % responded the graduation rate was between 0-25.

Procedure

Five primary research questions were posed in order to better understand the school counselor-student counseling relationship. Specific research questions and their associated hypotheses included:

1) Do school counselors endorse different educational and career recommendations based on the gender of the student?

Hypothesis: School counselors consider different educational and career paths to be appropriate based on the gender of the student. Such a gender bias will be shown in the differences in school counselors' responses based on the gender of the student in the vignette.

2) Do the educational and career path suggestions for students differ by gender of the counselor?

Hypothesis: School counselors of different genders will consider different educational and career paths appropriate for students. This effect will be revealed through a comparison of male versus female counselor recommendations regarding educational and career paths regardless of the gender of student.

3) Do school counselors consider different educational and career paths appropriate for students who demonstrate different personality attributes?

Hypothesis: School counselors will consider different educational and career paths appropriate for students who demonstrate different personality attributes. This relationship will be demonstrated in school counselors' responses to students who possess different personality attributes regardless of student gender and counselor gender.

4) Does the length of time a counselor has been employed as a counselor result in different educational and career path suggestions for students?

Hypothesis: School counselors of different stages in their careers will consider different educational and career paths appropriate for students. This effect will be revealed through a comparison of the number of years of employment the counselor reports and his or her recommendations of educational and career paths, regardless of the gender or personality attributes of student.

5) Is there an interaction between counselor gender and student gender, counselor gender and student trait, student gender and student trait, years working as a counselor and student gender or years working as a counselor and student trait with regard to how appropriate a counselor deems high school classes and college major?

Hypothesis: There will be no significant interactions effects between: counselor gender and student gender, counselor gender and student trait, student gender and student trait, years working as a counselor and student gender or years working as a counselor and student trait with regard to how appropriate a counselor deems high school courses and college majors.

Once the final data was collected, it was analyzed. Descriptive and inferential statistics were utilized to explore the hypotheses stated above. ANOVAs were conducted to explore main effects (hypotheses 1 – 4) and potential interaction effects (hypothesis 5). Post-hoc analyses were used to examine main effects for year of employment, since this variable is represented at five levels.

Quantitative: descriptive statistical analysis. Survey data analysis was conducted using SPSS software from IBM (SPSS.com, 2010). Analysis procedures involved the calculations of descriptive statistics including measures of central tendency and variance. While the mean and variance calculations help highlight counselors' beliefs, ANOVA analyses reveal whether the hypothesized relationships are statistically significant. 2 x 2 analyses of variance (ANOVA's) were conducted to explore the hypothesized interactions.

When describing the following findings it is important to remember the definition of each of the factors being described, as follows:

- Gender of student: Whether the student is female or male.
- Gender of counselor: Whether the counselor is female or male.
- Trait of student: Whether the student has been described as 1) A socially engaged student who is interested in helping people or 2) A non-conformist who is interested in recognition and achievement. It should be emphasized that both these students have identical scholarship, interests and class schedules.
- Length of time working as a counselor: How long the counselor has been working in this field (0-5, 5-10, 10-15, 15-20 and 20+ years). The following are the results of the data analysis from the national vignette.

Results

Descriptive statistics describing counselor ratings of the appropriateness of different educational and career choices for students (by student gender, counselor gender, student trait, number of years the counselor has worked in the field and interactions among these factors) are presented in Tables 5.1 through 5.66. The following is a description of the results of ANOVAs for these variables.

Counseling gender and student gender. No main effects for counselors' gender were observed in ratings of the appropriateness of high school classes or student majors (see Tables 5.1 to 5.11 for descriptive statistics). One main effect was detected for student gender in counselors' ratings of the appropriateness of engineering as a college major ($F = 4.33$ (1,181), $p = 0.039$, $\eta^2 = .02$, see Table 5.8 for descriptive statistics). Inspection of the unweight means suggests that counselors rated engineering as a more appropriate major for female students compared to male students. Upon closer inspection of the marginal means, however, it is clear that counselors rated engineering as a more appropriate major for male students (mean = 4.08) relative to female students (mean = 3.59).

A significant interaction between counselor and student gender was observed, however, for this dependent measure ($F = 9.22$, (1,181), $p = 0.003$, $\eta^2 = .048$). Specifically, male counselors declared that engineering was a significantly more appropriate major for male students (mean = 4.42) compared to female students (mean = 3.21). In contrast, female counselors declared that engineering was relatively equally appropriate for both male and female students (means = 3.75 and 3.97, respectively).

Counselor gender by student trait. Two by two ANOVAs were conducted to evaluate the main effects of counselor gender and student trait and the interaction between these two factors on counselors' ratings of the appropriateness of high school courses and college majors. Descriptive statistics for these analyses are shown in Tables 5.12 through 5.22. No counselor gender main effects were observed in terms of counselor ratings of the students' appropriateness for high school courses or college majors. Main effects for student trait were, however, observed in the following college majors: Engineering ($F = 11.718\ (1,181)$, $p = 0.001$, $\eta^2 = .061$, Table 5.19); Psychology ($F = 13.168\ (1,181)$, $p = 0.00$, $\eta^2 = .068$, Table 5.22.), and a single high school class; Physics ($F = 4.158\ (1,179)$, $p = 0.043$, $\eta^2 = .023$, Table 5.12). Counselors indicated that an engineering major was more appropriate for students with High Achieving traits (mean = 4.2) compared to students with a Helping People orientation (mean = 3.52). Similarly, counselors rated a high school physics class as more appropriate for High Achieving students (mean = 4.36) compared to students with a Helping People orientation (mean = 4.21) In contrast, counselors indicated that Psychology was a more appropriate major for students with the Helping People traits (mean = 4.0) in comparison to High Achieving traits (mean=3.1).

Two significant counselor gender by student trait interactions were observed. The first was observed in counselor ratings of the appropriateness of the education major ($F = 4.744\ (1,181)$, $p = .031$, $\eta^2 = .026$, Table 5.17). Specifically, male counselors rated education as a more appropriate major for students with High Achieving traits (mean= 3.92) relative to those with Helping People traits (mean=3.69) whereas the opposite was true for female counselors (Helping People mean = 4.13, High Achieving mean = 3.37).

A second significant interaction was observed in counselors' ratings of the appropriateness of high school calculus class ($F = 6.37\ (1,179)$, $p = .012$, $\eta^2 = .034$, Table 5.14). Similar to results observed with the education major, male counselors rated calculus as a more appropriate class for students with High Achieving traits (mean = 4.69) relative to those with Helping People traits (mean = 3.62). In contrast, female counselors rated calculus as equally appropriate for students with both High Achieving (mean = 4.33) and Helping People (mean = 4.32) traits.

<u>Student gender by student trait.</u> Descriptive statistics supporting the analyses of counselors' ratings of the appropriateness of high school courses and college majors as a function of both student gender and student trait are shown in Tables 5.23 through 5.33. A main effect for student gender was observed in counselors' ratings of the appropriateness of psychology as a college major (F = 4.30 (1,181), p = .040, η^2 = .023, Table 5.33). Specifically, counselors declared that psychology was a more appropriate college major for male students. Several main effects for student trait were observed. A main effect was observed for the appropriateness of high school advanced placement (AP) psychology classes (F = 6.60 (1,179), p = .011, η^2 = .036, Table 5.26). Counselors rated AP psychology courses as more appropriate for students with the Helping People trait relative to students with High Achieving traits. Main effects were also observed for the appropriateness of the following college majors: Education (F = 15.47 (1,181), p = .000, η^2 = .079, Table 5.28); Engineering (F = 18.272 (1,181), p = .000, η^2 = .092, Table 5.30); Prenursing (F = 18.35 (1,181), p = .000, η^2 = .092, Table 5.31); and Psychology (F = 31.55, (1,181), p = .000, η^2 = .148, Table 5.33). Specifically, counselors rated education, psychology, and prenursing majors as more appropriate for students with Helping People traits and engineering as more appropriate for students with High Achieving traits. No significant interaction effects were observed in counselor ratings of the appropriateness of high school courses and college majors as a function of student gender and trait.

<u>Number of years counselors working by student gender.</u> Descriptive statistics supporting the analyses of counselors' ratings of the appropriateness of high school courses and college majors as a function of the number of years counselors have been working and student gender are shown in Tables 5.34 through 5.44. A single gender main

effect was observed for the appropriateness of education as a college major (F = 4.65, (1,175), p = .032, η^2 = .126, Table 5.39). Specifically, counselors rated education as a more appropriate college major for male students.

Several main effects for the number of years counselors had worked were observed for both the appropriateness of high school classes and college major. With respect to high school classes, main effects were observed for Physics (F = 3.79, (1,173), p = .006, η^2 = .081, Table 5.34); AP English (F = 4.92, (1,173), p = .001, η^2 = .102, Table 5.35); Calculus (F = 2.87, (1,173), p = .025, η^2 = .062, Table 5.36); AP Psychology (F = 2.97, (1,173), p = .021, η^2 = .064, Table 5.37); and practical job training (F = 3.09, (1,173), p = .017, η^2 = .067, Table 5.38). With respect to college majors, main effects were observed for Education (F = 4.48, (1,175), p = .002, η^2 = .092, Table 5.39); Biology (F = 3.75, (1,175), p = .006, η^2 = .079, Table 5.40); Prenursing (F = 4.50, (1,175), p = .002, η^2 = .093, Table 5.42); and Psychology (F = 3.75, (1,175), p = .006, η^2 = .079, Table 5.44).

Post-hoc analyses of these main effects are presented in Tables 5.45 through 5.55. No consistent and easily interpretable patters emerged in pairwise comparisons among groups (representing different years of counseling service). Generally, however, counselors working in the field fewer than 5 years perceived most majors/classes to be less appropriate for students than their more experienced counterparts. For example, for education a mean difference of (-.82) was seen between counselors working 1-5 years and those working 5-10 years. Similarly, a mean difference of -.54 was seen between counselors working 1-5 years and 10-15 years. In both cases, the more experienced counselors rated the education major as more appropriate for students. This pattern is observed in other majors such as biology/premed, prenursing, finance, psychology, and physics, and classes including AP English, AP psychology.

No significant interaction effects were observed in counselor ratings of the appropriateness of high school courses and college majors as a function of student gender and the number of years they had worked.

Number of years counselors working by student trait. Descriptive statistics supporting the analyses of counselors' ratings of the appropriateness of high school courses and academic majors by number of years spent on the job and student trait are presented in Tables 5.56 through 5.66.

A number of single trait main effects were observed for both high school classes and college majors. A significant main effect for counselor ratings of the appropriateness of high school classes was observed for AP Psychology ($F = 6.82$, (1,173), $p = .01$, $\eta^2 = .038$, Table 5.59). Counselors rated AP psychology courses as more appropriate for students with the Helping People trait relative to students with High Achieving traits. Main trait effects for college majors were observed for Engineering ($F = 16.04$, (1,175), $p = .000$, $\eta^2 = .084$, Table 5.63); Education ($F = 6.571$, (1,175), $p = .011$, $\eta^2 = .136$, Table 5.56); Prenursing ($F = 14.73$, (1,175), $p = .000$, $\eta^2 = .078$, Table 5.64); and Psychology ($F = 20.70$, (1,175), $p = .000$, $\eta^2 = .106$, Table 5.66). Similar to previously reported results, counselors rated education, psychology, and prenursing majors as more appropriate for students with Helping People traits and engineering as more appropriate for students with High Achieving traits.

Several main effects for the number of years counselors had worked were observed for both the appropriateness of high school classes and college major. With respect to high school classes, main effects were observed for Physics ($F = 3.97$, (1,173),

$p = .004$, $\eta^2 = .084$, Table 5.56); AP English ($F = 4.96$, (1,173), $p = .001$, $\eta^2 = .103$, Table 5.57); Calculus ($F = 3.31$, (1,173), $p = .012$, $\eta^2 = .071$, Table 5.58); AP Psychology ($F = 2.97$, (1,173), $p = .021$, $\eta^2 = .064$, Table 5.59); and practical job training ($F = 2.43$, (1,173), $p = .050$, $\eta^2 = .053$, Table 5.60). With respect to college majors, main effects were observed for Education ($F = 3.64$, (1,175), $p = .007$, $\eta^2 = .077$, Table 5.61); Biology ($F = 3.66$, (1,175), $p = .007$, $\eta^2 = .077$, Table 5.62); Engineering, ($F = 2.94$, (1,175), $p = .022$, $\eta^2 = .063$, Table 5.63); Prenursing ($F = 3.79$, (1,175), $p = .006$, $\eta^2 = .080$, Table 5.64), and Psychology ($F = 2.56$, (1,175), $p = .040$, $\eta^2 = .055$, Table 5.66).

Post-hoc analyses for these main effects are identical to those presented in the previous section and are thus displayed in Tables 5.45 through 5.55.

No significant interaction effects were observed in counselor ratings of the appropriateness of high school courses and college majors as a function of student trait and the number of years they had worked.

The first step in the qualitative study was to perform content analysis. Content analysis was performed in order to better understand the meaning of the provided answers. In order to do this the contextual information was first converted into a more relevant, manageable data set (Berelson, 1952; Rosengren, 1981; Weber, 1990). The central goal in content analysis was to classify words, phrases or other units of text into a limited number of meaningful categories that are relevant to the research hypothesis.

For this study, data analysis was in the form of words and phrases written by participants. From there, the words and phrases were converted into themes or “utterances” (Erickson, 1986). The text was then examined to establish all the distinct themes (Stiles, 1978). Then we established how the units of texts were coded. For this, data were coded through classification. Each unit was categorized into one of several, exclusive categories. The responses of participants were categorized into predetermined groups based on their themes and through preliminary analysis the finalized themes

As mentioned earlier, the qualitative portion of the data analysis was conducted using theme coding. Comparisons were made in both personality traits and gender. Each counselor was asked: What attributes about Jane/John contribute to your decision that engineering is/is not appropriate? Each counselor answered this question one time based on the version of the vignette they were randomly assigned. The results demonstrate a clear difference in how counselors answered based on both gender and personality attributes.

For Jane 1 (Helping Others) the number one reason given for why engineering was appropriate was her skill set (Figure 5.1). Examples of these responses were because she was "doing well in her class" and that she was "good at math." The second-highest response was that she was NOT appropriate. This answer was usually based on the fact that she was "too social to be an engineer." The third-highest endorsed theme was her desire to help people as a reason she was not appropriate for engineering. Jane's personality characteristics were also seen as reasons engineering was not an appropriate major. The two least endorsed themes were her personality and her desire to help people as characteristics that were congruent with an engineering major.

For Jane 2 (High Achieving) the most highly endorsed reason that engineering would be an appropriate major is once again due to her skill set (Figure 5.2). Interestingly, for Jane 2, her personality characteristics were seen as much more congruent that Jane 1. For instance, the fact that she was described as "non-conformist" and as "wanting recognition" were both highly endorsed reasons for why an engineering major was appropriate. Her interest in the field was also highly endorsed. For Jane 2, the lowest endorsed theme was that engineering was not appropriate.

When the same question was answered about John 1 (Helping Others) and John 2 (High Achieving) many of the same themes arose as with the Jane vignette; however, they were endorsed at significantly different rates. While the number one theme for why engineering was appropriate for John 1 was once again his perceived skills, the second-highest endorsed theme for why engineering was appropriate was due to his desire to help others (Figure 5.3) John 1's personality (third-highest) was also seen as congruent with an engineering major. In fact, it was not until the fourth-highest endorsed theme (his desire to work with people) that engineering was seen as an inappropriate major. His desire to help people being a reason engineering was not appropriate was the fifth-highest endorsed theme, followed by his personality and the desire to work with people.

John 2 was by far seen as possessing characteristics that were most appropriate for an engineering major (Figure 5.4). For instance, John 2 was the only vignette in which all of the themes endorsed by counselors indicated engineering as an appropriate major. The most highly endorsed theme for John 1 was once again his skill set, followed by the fact that he was described as "non – conformist", which was closely followed by his perceived interest in the field. The last theme for John was his desire for recognition.

In investigating differences between Jane 1(Helping Others) and Jane 2 (High Achieving; Figures 5.1- 5.2); we found differences in counselor responses based on the following categorization. Jane 1 was reported to be "socially engaged and involved in student activities while expressing a strong desire to help others," while Jane 2 was reported to be "a non-conformist and expressing interest in a work environment in which achievement is highly valued and where she will receive recognition for her hard work."

The difference in counselor response was observed despite keeping all other components of the description of the students consistent (achievement and interest) and therefore may be attributed to the personality characteristics of the students. Helping People Jane is much more likely to be told engineering is “not appropriate” and that her “desire to help others” as well as her “personality” are both reasons given for why engineering is *not* an appropriate career choice for her. Conversely, High Achieving Jane is determined to be a much more appropriate fit for an engineering major, specifically because of her described “skill level” and “interest.” Further, her “non-conformity” and “desire for recognition” are factors that counselors believed made engineering an appropriate major.

In comparing Helping People John with High Achieving John (see Figures 5.3-5.4), Helping People John 1’s desire to help others is seen as predominantly a positive attribute in his deciding that engineering was an appropriate major. Though both Johns are seen as equally “skilled,” an engineering major was seen as more appropriate for High Achieving due to his “interests.” Further, his “non-conformity” and “desire for recognition” were also predominant reasons why engineering was more appropriate for High Achieving John 2 than Helping People John 2.

In comparing the two genders (see Figures 5.1 and 5.3); we see that engineering is seen as much less appropriate for Helping People John or Jane than it is for their High Achieving counterparts. However, based on the student’s gender, counselors seemed to have differing reasons for why engineering was appropriate. Counselors indicated “skills and ability” as the most predominant reasons John was appropriate for engineering, while counselors reported Jane’s “personality” as a less appropriate fit for engineering. Conversely, counselors declared John’s personality to be one of the leading factors in his appropriateness for the engineering field. Further, while Jane’s “desire to help others” was one of the top reasons she was *not appropriate* for engineering; it was the second highest factor for why John *was appropriate*. Lastly, but perhaps most importantly, Jane was consistently reported to be an inappropriate candidate for an engineering major, while John was *never* deemed inappropriate.

Similarly to previous results (see Figures 5.2 and 5.4) counselors indicated that engineering was not an appropriate major for High Achieving Jane, while High Achieving John was never deemed inappropriate. However, aside from that difference, high achieving personality characteristics seem to fit with the school counselors' perception of engineers regardless of gender, and thus were endorsed more appropriate for engineering at a much higher rate than those with helping people personality characteristics.

Counselors were also asked what they felt may be an appropriate career for the student in each vignette. Their answers were categorized by theme and six categories were established, including: 1) Social/Behavioral/Liberal arts, 2) Health Science, 3) Engineering, 4) Business, 5) Education/ Humanities and 6) Biology. For High Achieving John 2 and Jane 2 careers in engineering, business and education were found to be most appropriate, while for Helping People John 1 and Jane 1 careers in the social/behavioral/liberal arts and health science were seen as more appropriate (see Figure 5.5). Interestingly, for both the education and humanities fields, the Jane 1 (social/help others) and John 2 (nonconformist/recognition) were the most highly endorsed students. Though further investigation must be done, perhaps one reasoning for this surprising result could be that the social/help others personality attribute described for Jane 1 may be viewed as a good fit with a career in early education or high school teaching, while the high achieving description of John 2 may be seen as congruent with a career such as professor. These speculations are somewhat warranted, given the gender disparities in both elementary/high school education (76% female) and higher education (23% of full professors are female; Mason, 2010). Perhaps most importantly, it seems that any student who is described as wanting to help people, regardless of his or her achievement or reported interest, is much more likely to be considered fitting with the medical profession than with engineering. This is an important observation, as it demonstrates the influence perceptions of personality attributes have on what courses and majors counselors may find appropriate.

Conclusion

These data have confirmed that both male and female counselors find different careers more or less appropriate for students based on both student gender and student personality attributes. This is demonstrated through the fact that counselors are more likely to believe majors such as education, prenursing and psychology are more appropriate for those with helping people personality characteristics, while engineering majors and high school physics courses are more appropriate for students with high achieving characteristics.

In regards to gender, marginal means demonstrate that overall counselors declared engineering as a more appropriate major for male students than female students. Further, male counselors declared that engineering was a significantly more appropriate major for male students compared to female students, while female counselors reported that engineering was relatively equally appropriate for both male and female students. Generally, this data seems to indicate that male counselors are more likely to have a larger discrepancy between their responses to what courses and majors are appropriate compared to their female counterparts. Further, we see male counselors upholding at least one traditionally male field at a higher rate than we do female counselors.

Similarly, male counselors' rating of the appropriateness of the education major indicated a higher endorsement for students with high achieving traits relative to those with helping people traits, whereas the opposite was true for female counselors. Further, in rating the appropriateness of high school calculus courses, male counselors rated calculus as a more appropriate class for students with high achieving traits relative to those with helping people traits. In contrast, female counselors rated calculus as equally appropriate for students with both high achieving and helping people traits. Once again, this data seems to indicate that male counselors are more likely to have a larger discrepancy between what courses and majors are appropriate compared to their female counterparts. This reveals one area in which intervention can be established. For instance, raising awareness about what counselors deemed appropriate may lead to more enlightened recommendations when working with college-bound students. Educating counselors about the implications of these results may also be beneficial in decreasing the effects that student personality attributes and gender may have on counselors' beliefs on appropriate course and major choices.

Interestingly, counselors declared psychology as a more appropriate college major for male students than female students. This result seems surprising, given the earlier results in that psychology was often seen as an appropriate major for students with helping people traits, which are stereotypically associated with female gender roles. Further, counselors rated AP psychology courses and education, psychology and prenursing majors as more appropriate for students with helping people traits and engineering as more appropriate for students with high achieving traits. With the exception of the psychology major, it seems that both male and female counselors display some difference in their ideas of what personality attributes may be appropriate for certain courses and majors. Knowledge of their influence on students, and these results may warrant further investigation of counselor training around gender bias, societal influences, and traditionally male and female careers in order to decrease these influences on may be deemed appropriate.

Counselors' ratings of the appropriateness of high school courses and college majors as a function of the number of years counselors have been working and student gender demonstrate that counselors rated education as a more appropriate college major for male students. Counselors' ratings of the appropriateness of high school courses and college majors as a function of the number of years counselors have been working and student trait demonstrate that counselors rated AP psychology courses as more appropriate for students with the helping people trait relative to students with high achieving traits. Similar to previously reported results, counselors rated education, psychology, and prenursing majors as more appropriate for students with helping people traits and engineering as more appropriate for students with high achieving traits. In general, counselors working in the field fewer than 5 years perceived most majors/classes to be less appropriate for students than their more experienced counselor counterparts. For example, for education counselors working between 1-5 years found the major overall less appropriate than those working 5-10 years. Similarly, this pattern is observed in other majors, including biology/premed, prenursing, finance, psychology, and classes including AP English, AP psychology and physics.

Using qualitative research, we once again established differences in counselors' response of what courses and majors were appropriate based on gender and personality attributes. First, categorizing one student as “socially engaged and involved in student activities while expressing a strong desire to help others” and comparing her to a student categorized as “being a non-conformist and expressing interest in a work environment in which achievement is highly valued and where she will receive recognition for her hard work,” while keeping all other components of the description of the students consistent (interest in classes and achievement), resulted in differences in response. The differences in response, therefore, can be attributed to the personality characteristics of the students. Students characterized as having helping people traits were more likely to be told engineering is “not appropriate” and that “desire to help others” and “personality” were reasons why engineering was *not* an appropriate career choice. High achieving personality characteristics garnered responses that “nonconformity” and “desire for recognition” are both contributing factors to why the student *should* consider engineering. Interestingly, only the students possessing high achieving personality attributes were seen to have interests congruent with engineering.

When gender is established as a variable, counselors once again revealed differences in what they deemed appropriate courses and majors. In comparing the two genders, we see that engineering was deemed to be less appropriate overall for female students regardless of personality characteristics than it was for male students.

Results from these studies cannot rule out the possibility that gender disparity in traditionally male or female fields may, at least in part, be influenced by the attitudes and beliefs of practicing school counselors. As discussed in earlier chapters of this dissertation, the main objective of this research was to provide an in depth study of gender disparity in STEM and engineering college majors and professional careers. Results demonstrate that there are some congruencies between the data collected and the hypothesized relationships. Further, results demonstrate that the perception of the personality attributes or gender of a student may have an impact on how appropriate a counselor may find specific courses or majors.

The vignettes:

Jane/John is a sophomore in high school. Her teachers describe her as bright, outgoing, socially engaged **and involved in student activities**. She has received high grades in high school algebra, geometry, biology, and chemistry. She reports enjoying her classes and taking pride in her coursework. In discussing Jane's academic and career future she **expresses a strong desire to help others.**

John/Jane is a sophomore in high school. His teachers describe him as bright, outgoing, **and a non-conformist**. He has received high grades in high school algebra, geometry, biology, and chemistry. He reports enjoying his classes and takes pride in doing well. In discussing John's academic and career future he expresses a **strong desire to pursue a career in an environment in which achievement is highly valued and where he will receive recognition for his hard work.**

Figure 5.1

National vignette examples

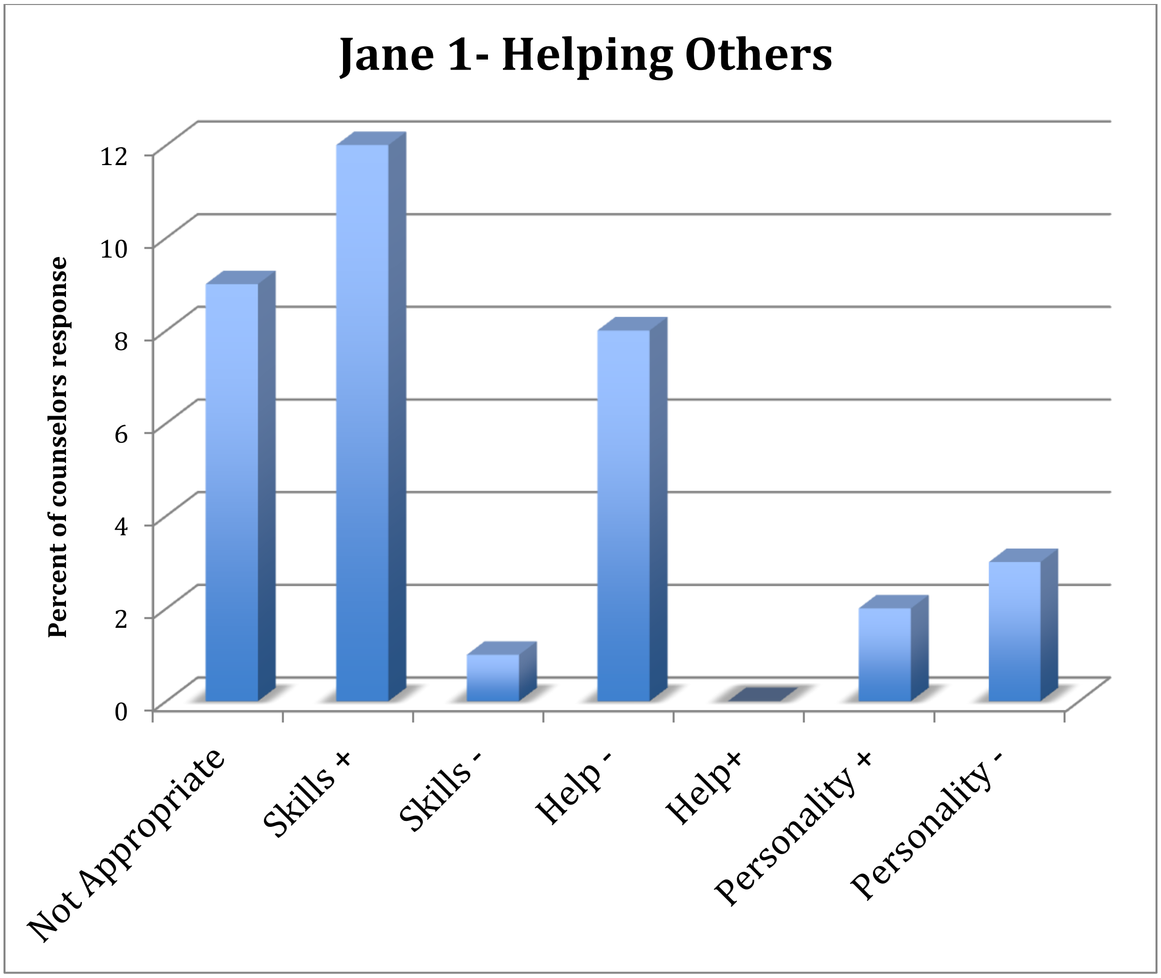

Figure 5.2

What attributes about the student in this vignette contribute to your decision that engineering is or is not appropriate (Jane 1)?

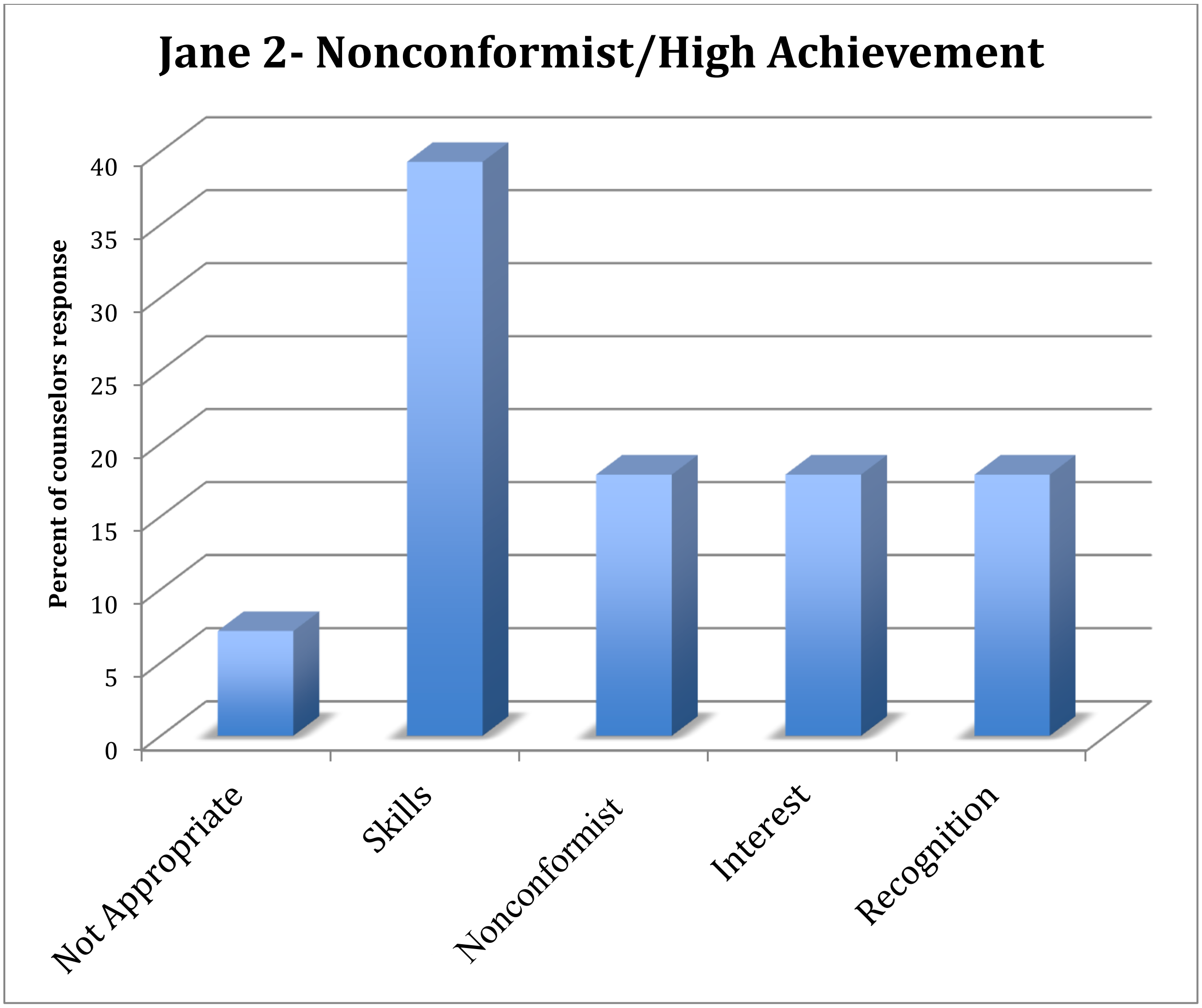

Figure 5.3

What attributes about the student in this vignette contribute to your decision that engineering is or is not appropriate (Jane 2)?

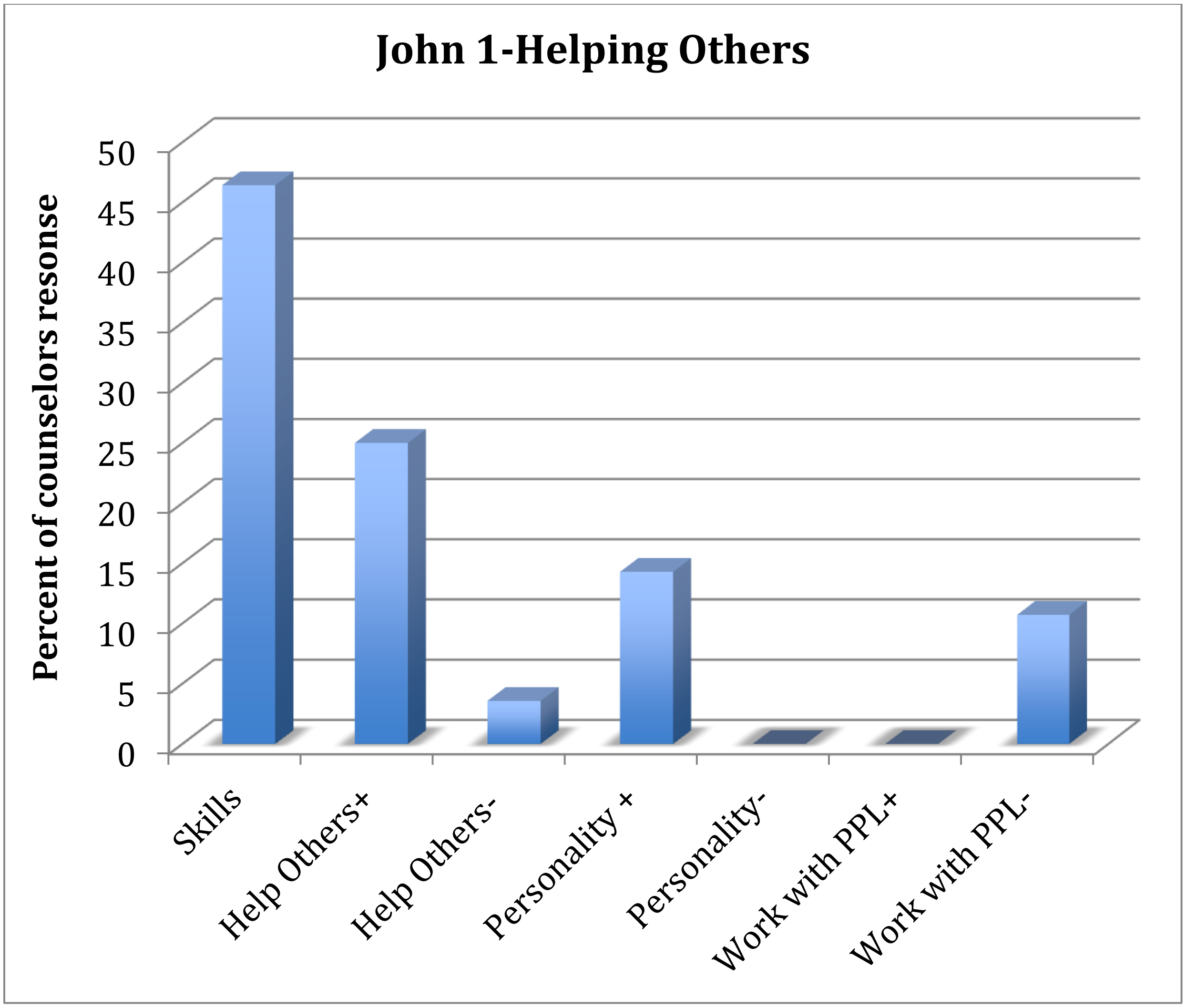

Figure 5.4

What attributes about the student in this vignette contribute to your decision that engineering is or is not appropriate (John 1)?

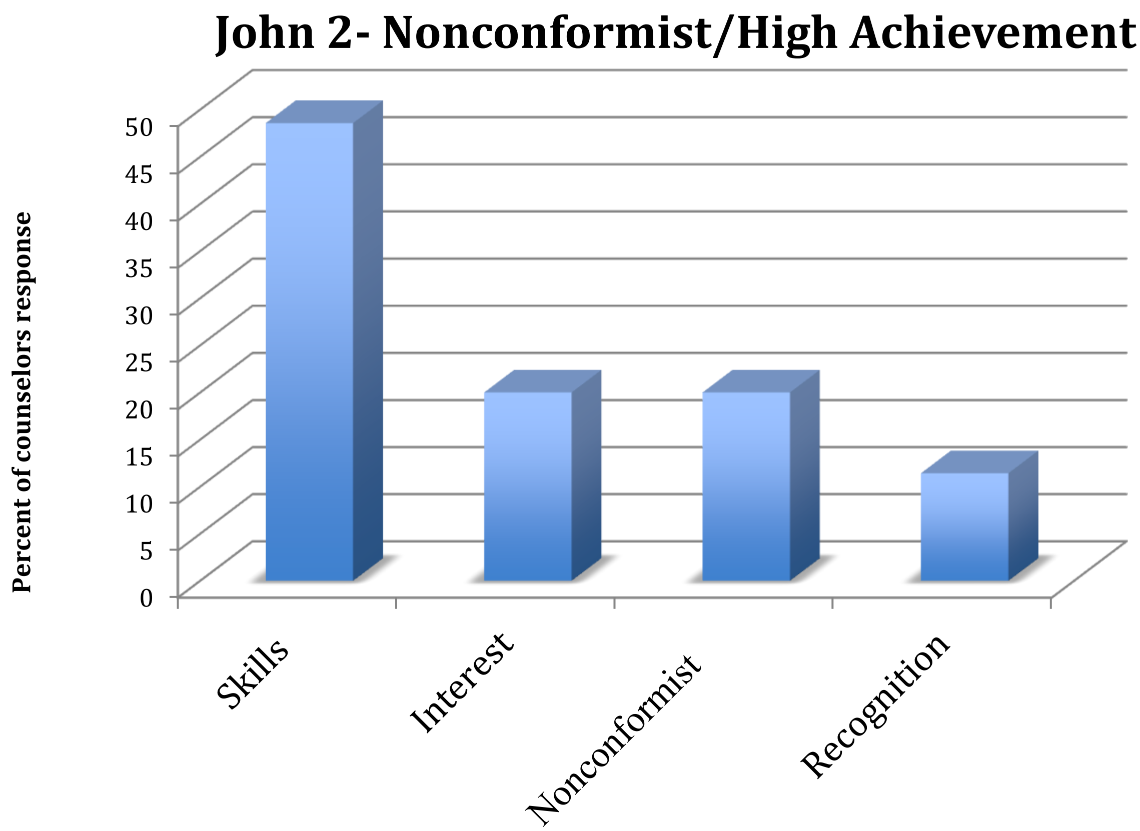

Figure 5.5

What attributes about the student in this vignette contribute to your decision that engineering is or is not appropriate (John 2)?

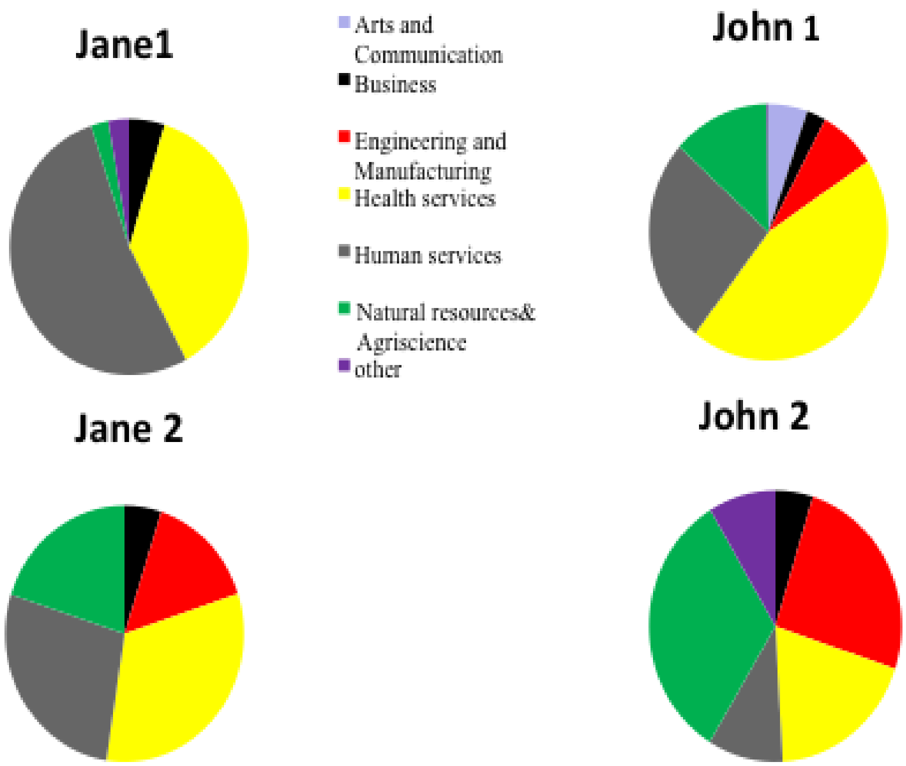

Figure 5.6

Counselors were also asked what they felt may be an appropriate career for the student in each vignette

Table 5.1

Descriptive Statistics: Ratings of Appropriateness of High School Physics Course by Student Gender and Counselor Gender

Student Gender	Counselor Gender	*n*	$\overline{X}$	*s*
Female	Male	14	4.21	1.19
	Female	79	4.40	0.94
	Total	93	4.37	0.98
Male	Male	12	4.17	1.11
	Female	80	4.20	1.08
	Total	92	4.20	1.08
Total	Male	26	4.19	1.13
	Female	159	4.30	1.01
	Total	185	4.28	1.03

Table 5.2

Descriptive Statistics: Ratings of Appropriateness of High School AP English Course by Student Gender and Counselor Gender

Student Gender	Counselor Gender	*n*	$\overline{X}$	*s*
Female	Male	14	3.64	1.15
	Female	79	3.96	1.06
	Total	93	3.91	1.08
Male	Male	12	3.92	1.24
	Female	80	3.84	1.13
	Total	92	3.85	1.14
Total	Male	26	3.77	1.18
	Female	159	3.90	1.09
	Total	185	3.88	1.10

Table 5.3

Descriptive Statistics: Ratings of Appropriateness of High School Calculus Course by Student Gender and Counselor Gender

Student Gender	Counselor Gender	n	$\overline{X}$	s
Female	Male	14	4.14	1.17
	Female	79	4.44	0.89
	Total	93	4.39	0.94
Male	Male	12	4.17	1.19
	Female	80	4.22	1.06
	Total	92	4.21	1.07
Total	Male	26	4.15	1.16
	Female	159	4.32	0.98
	Total	185	4.30	1.01

Table 5.4

Descriptive Statistics: Ratings of Appropriateness of High School AP Psychology Course by Student Gender and Counselor Gender

Student Gender	Counselor Gender	n	$\overline{X}$	s
Female	Male	14	3.79	1.12
	Female	79	4.21	1.05
	Total	93	4.14	1.07
Male	Male	12	3.75	1.29
	Female	80	3.92	1.02
	Total	92	3.90	1.06
Total	Male	26	3.77	1.18
	Female	159	4.06	1.04
	Total	185	4.02	1.06

Table 5.5

Descriptive Statistics: Ratings of Appropriateness of High School Practical Job-Readiness Training Courses by Student Gender and Counselor Gender

Student Gender	Counselor Gender	*n*	$\overline{X}$	*s*
Female	Male	14	2.71	1.33
	Female	79	2.94	1.17
	Total	93	2.90	1.19
Male	Male	12	2.58	1.38
	Female	80	3.10	1.31
	Total	92	3.03	1.32
Total	Male	26	2.65	1.33
	Female	159	3.02	1.24
	Total	185	2.97	1.25

Table 5.6

Descriptive Statistics: Ratings of Appropriateness of Education Major by Student Gender and Counselor Gender

Student Gender	Counselor Gender	*n*	$\overline{X}$	*s*
Female	Male	14	3.79	1.05
	Female	79	3.94	1.09
	Total	93	3.91	1.08
Male	Male	12	3.83	1.12
	Female	80	3.60	1.18
	Total	92	3.63	1.17
Total	Male	26	3.81	1.06
	Female	159	3.77	1.14
	Total	185	3.77	1.13

Table 5.7

Descriptive Statistics: Ratings of Appropriateness of Biology/Premedicine Major by Student Gender and Counselor Gender

Student Gender	Counselor Gender	n	$\overline{X}$	s
Female	Male	14	3.93	1.21
	Female	79	4.54	1.00
	Total	93	4.45	1.01
Male	Male	12	4.24	1.17
	Female	80	4.26	1.10
	Total	92	3.63	1.10
Total	Male	26	4.15	1.19
	Female	159	4.39	1.03
	Total	185	4.36	1.05

Table 5.8

Descriptive Statistics: Ratings of Appropriateness of Engineering Major by Student Gender and Counselor Gender

Student Gender	Counselor Gender	*n*	$\overline{X}$	*s*
Female	Male	14	3.21	1.19
	Female	79	3.97	1.15
	Total	93	3.86	1.19
Male	Male	12	4.42	1.17
	Female	80	3.75	1.04
	Total	92	3.84	1.07
Total	Male	26	3.77	1.31
	Female	159	3.86	1.10
	Total	185	3.85	1.13

Table 5.9

Descriptive Statistics: Ratings of Appropriateness of Prenursing Major by Student Gender and Counselor Gender

Student Gender	Counselor Gender	*n*	$\overline{X}$	*s*
Female	Male	14	3.64	1.28
	Female	79	4.11	1.16
	Total	93	4.04	1.18
Male	Male	12	3.92	1.44
	Female	80	3.82	1.13
	Total	92	3.84	1.17
Total	Male	26	3.77	1.34
	Female	159	3.97	1.15
	Total	185	3.94	1.18

Table 5.10

Descriptive Statistics: Ratings of Appropriateness of Finance Major by Student Gender and Counselor Gender

Student Gender	Counselor Gender	*n*	$\overline{X}$	*s*
Female	Male	14	2.79	1.00
	Female	79	2.99	1.20
	Total	93	2.96	1.17
Male	Male	12	3.58	1.00
	Female	80	2.89	1.02
	Total	92	2.98	1.04
Total	Male	26	3.15	1.05
	Female	159	2.94	1.11
	Total	185	2.97	1.10

Table 5.11

Descriptive Statistics: Ratings of Appropriateness of Psychology Major by Student Gender and Counselor Gender

Student Gender	Counselor Gender	*n*	$\overline{X}$	*s*
Female	Male	14	3.36	1.01
	Female	79	3.80	1.23
	Total	93	3.73	1.21
Male	Male	12	3.25	1.60
	Female	80	3.42	1.07
	Total	92	3.40	1.14
Total	Male	26	3.31	1.29
	Female	159	3.61	1.16
	Total	185	3.57	1.18

Table 5.12

Descriptive Statistics: Ratings of Appropriateness of High School Physics Course by Student Trait and Counselor Gender

Counselor Gender	Student Trait	*n*	$\overline{X}$	*s*
M	HP	13	3.77	1.36
	HA	13	4.62	0.65
	Total	26	4.19	1.13
F	HP	82	4.28	1.00
	HA	75	5.32	1.04
	Total	157	4.3	1.02
Total	HP	95	4.21	1.06
	HA	88	4.36	1.00
	Total	184	4.28	1.03

Table 5.13

Descriptive Statistics: Ratings of Appropriateness of High School AP English Course by Student Trait and Counselor Gender

Counselor Gender	Student Trait	*n*	$\overline{X}$	*s*
M	HP	13	3.46	1.27
	HA	13	4.08	1.04
	Total	26	3.77	1.18
F	HP	83	4.04	1.07
	HA	76	3.75	1.10
	Total	159	3.90	1.10
Total	HP	96	3.96	1.11
	HA	89	3.80	1.11
	Total	185	3.88	1.10

Table 5.14

Descriptive Statistics: Ratings of Appropriateness of High School Calculus Course by Student Trait and Counselor Gender

Counselor Gender	Student Trait	*n*	$\overline{X}$	*s*
M	HP	13	3.62	1.33
	HA	13	4.69	0.63
	Total	26	4.15	1.16
F	HP	82	4.32	1.00
	HA	75	4.33	1.04
	Total	157	4.32	1.00
Total	HP	95	4.22	1.01
	HA	88	4.39	1.00
	Total	184	4.3	1.01

Table 5.15

Descriptive Statistics: Ratings of Appropriateness of High School AP Psychology Course by Student Trait and Counselor Gender

Counselor Gender	Student Trait	*n*	$\overline{X}$	*s*
M	HP	13	3.62	1.38
	HA	13	3.92	1.33
	Total	26	3.77	1.33
F	HP	83	4.30	1.28
	HA	76	3.80	1.16
	Total	159	4.06	1.24
Total	HP	96	4.21	1.30
	HA	89	3.82	1.18
	Total	185	4.02	1.25

Table 5.16

Descriptive Statistics: Ratings of Appropriateness of High School Practical Job-Readiness Training Courses by Student Trait and Counselor Gender

Counselor Gender	Student Trait	*n*	$\overline{X}$	*s*
M	HP	13	2.69	1.38
	HA	13	2.62	1.33
	Total	26	2.65	1.33
F	HP	83	3.21	1.28
	HA	76	2.81	1.16
	Total	159	3.02	1.24
Total	HP	96	3.14	1.30
	HA	89	2.78	1.18
	Total	185	2.97	1.25

Table 5.17

Descriptive Statistics: Ratings of Appropriateness of Education Major by Student Trait and Counselor Gender

Counselor Gender	Student Trait	*n*	$\overline{X}$	*s*
M	HP	13	3.69	1.38
	HA	13	3.92	0.64
	Total	26	3.81	1.06
F	HP	82	4.13	1.08
	HA	75	3.37	1.08
	Total	157	3.77	1.14
Total	HP	95	4.07	1.13
	HA	88	3.45	1.05
	Total	184	3.77	1.13

Table 5.18

Descriptive Statistics: Ratings of Appropriateness of Biology/Premedicine Major by Student Trait and Counselor Gender

Counselor Gender	Student Trait	*n*	$\overline{X}$	*s*
M	HP	13	3.92	1.50
	HA	13	4.38	0.77
	Total	26	4.15	1.19
F	HP	83	4.49	0.99
	HA	76	4.28	1.07
	Total	159	4.39	1.03
Total	HP	96	4.42	1.08
	HA	89	4.29	1.03
	Total	185	4.36	1.05

Table 5.19

Descriptive Statistics: Ratings of Appropriateness of Engineering Major by Student Trait and Counselor Gender

Counselor Gender	Student Trait	*n*	$\overline{X}$	*s*
M	HP	13	3.31	1.32
	HA	13	4.23	1.17
	Total	26	3.77	1.31
F	HP	82	3.55	1.02
	HA	75	4.20	1.10
	Total	157	3.86	1.10
Total	HP	95	3.52	1.06
	HA	88	4.20	1.10
	Total	184	3.85	1.18

Table 5.20

Descriptive Statistics: Ratings of Appropriateness of Prenursing Major by Student Trait and Counselor Gender

Counselor Gender	Student Trait	*n*	$\overline{X}$	*s*
M	HP	13	3.77	1.42
	HA	13	3.77	1.30
	Total	26	3.77	1.34
F	HP	83	4.36	0.99
	HA	76	3.56	1.07
	Total	159	3.97	1.03
Total	HP	96	4.28	1.08
	HA	89	3.57	1.03
	Total	185	3.94	1.05

Table 5.21

Descriptive Statistics: Ratings of Appropriateness of Finance Major by Student Trait and Counselor Gender

Counselor Gender	Student Trait	*n*	$\overline{X}$	*s*
M	HP	13	2.92	1.32
	HA	13	3.38	0.65
	Total	26	3.15	1.05
F	HP	83	3.04	1.08
	HA	76	2.83	1.15
	Total	159	2.94	1.11
Total	HP	96	3.02	1.11
	HA	89	2.91	1.10
	Total	185	2.97	1.10

Table 5.22

Descriptive Statistics: Ratings of Appropriateness of Psychology Major by Student Trait and Counselor Gender

Counselor Gender	Student Trait	*n*	$\overline{X}$	*s*
M	HP	13	3.69	1.38
	HA	13	2.92	1.12
	Total	26	3.31	1.29
F	HP	83	4.05	1.05
	HA	76	3.13	1.10
	Total	159	3.63	1.16
Total	HP	96	4.00	1.10
	HA	89	3.10	1.10
	Total	185	3.57	1.18

Table 5.23

Descriptive Statistics: Ratings of Appropriateness of High School Physics Course by Student Trait and Student Gender

Student Trait	Student Gender	*n*	$\overline{X}$	*s*
Help People	Male	48	4.26	1.03
	Female	48	4.17	1.10
	Total	96	4.21	1.06
High Achieving	Male	45	4.49	0.92
	Female	44	4.23	1.07
	Total	89	4.36	1.10
Total	Male	93	4.37	0.98
	Female	92	4.20	1.08
	Total	185	4.28	1.03

Table 5.24

Descriptive Statistics: Ratings of Appropriateness of High School AP English Course by Student Trait and Student Gender

Student Trait	Student Gender	*n*	$\overline{X}$	*s*
Help People	Male	48	4.00	1.10
	Female	48	3.92	1.13
	Total	96	3.96	1.11
High Achieving	Male	45	3.82	1.05
	Female	44	3.77	1.15
	Total	89	3.80	1.10
Total	Male	93	3.91	1.08
	Female	92	3.85	1.14
	Total	185	3.88	1.10

Table 5.25

Descriptive Statistics: Ratings of Appropriateness of High School Calculus Course by Student Trait and Student Gender

Student Trait	Student Gender	n	$\overline{X}$	s
Help People	Male	48	4.30	0.93
	Female	48	4.15	1.09
	Total	96	4.22	1.01
High Achieving	Male	45	4.49	0.94
	Female	44	4.28	1.05
	Total	89	4.39	0.99
Total	Male	93	4.39	0.94
	Female	92	4.21	1.07
	Total	185	4.30	1.01

Table 5.26

Descriptive Statistics: Ratings of Appropriateness of High School AP Psychology Course by Student Trait and Student Gender

Student Trait	Student Gender	*n*	$\overline{X}$	*s*
Help People	Male	47	4.29	1.04
	Female	48	4.16	1.09
	Total	95	4.21	1.06
High Achieving	Male	45	4.00	1.09
	Female	43	3.63	0.95
	Total	88	3.82	1.03
Total	Male	92	4.14	1.07
	Female	91	3.90	1.06
	Total	183	4.02	1.06

Table 5.27

Descriptive Statistics: Ratings of Appropriateness of High School Practical Job-Readiness Training Courses by Student Trait and Student Gender

Student Trait	Student Gender	*n*	$\overline{X}$	*s*
Help People	Male	47	3.06	1.31
	Female	48	3.21	1.30
	Total	95	3.14	1.30
High Achieving	Male	45	2.73	1.03
	Female	43	2.83	1.33
	Total	88	2.78	1.18
Total	Male	92	2.90	1.19
	Female	91	3.03	1.32
	Total	183	2.97	1.25

Table 5.28

Descriptive Statistics: Ratings of Appropriateness of Education Major by Student Trait and Student Gender

Student Trait	Student Gender	n	$\overline{X}$	s
Help People	Male	48	4.15	1.07
	Female	48	4.00	1.19
	Total	96	4.07	1.13
High Achieving	Male	45	3.67	1.04
	Female	44	3.23	1.01
	Total	89	3.45	1.05
Total	Male	93	3.91	1.08
	Female	92	3.63	1.17
	Total	185	3.77	1.13

Table 5.29

Descriptive Statistics: Ratings of Appropriateness of Biology/Premedicine Major by Student Trait and Student Gender

Student Trait	Student Gender	*n*	$\overline{X}$	*s*
Help People	Male	48	4.48	1.05
	Female	48	4.35	1.12
	Total	96	4.42	1.08
High Achieving	Male	45	4.42	0.97
	Female	44	4.16	1.07
	Total	89	4.29	1.03
Total	Male	93	4.45	1.01
	Female	92	4.26	1.10
	Total	185	4.36	1.05

Table 5.30

Descriptive Statistics: Ratings of Appropriateness of Engineering Major by Student Trait and Student Gender

Student Trait	Student Gender	*n*	$\overline{X}$	*s*
Help People	Male	48	3.50	1.15
	Female	48	3.54	0.97
	Total	96	3.52	1.06
High Achieving	Male	45	4.24	1.11
	Female	44	4.16	1.10
	Total	89	4.20	1.10
Total	Male	93	3.86	1.19
	Female	92	3.84	1.07
	Total	185	3.85	1.13

Table 5.31

Descriptive Statistics: Ratings of Appropriateness of Prenursing Major by Student Trait and Student Gender

Student Trait	Student Gender	*n*	$\overline{X}$	*s*
Help People	Male	48	4.42	1.05
	Female	48	4.15	1.13
	Total	96	4.28	1.09
High Achieving	Male	45	3.64	1.19
	Female	44	3.50	1.31
	Total	89	3.57	1.16
Total	Male	93	4.04	1.18
	Female	92	3.84	1.17
	Total	185	3.94	1.18

Table 5.32

Descriptive Statistics: Ratings of Appropriateness of Finance Major by Student Trait and Student Gender

Student Trait	Student Gender	*n*	$\overline{X}$	*s*
Help People	Male	48	2.88	1.18
	Female	48	3.17	1.02
	Total	96	3.02	1.11
High Achieving	Male	45	3.04	1.17
	Female	44	2.77	1.03
	Total	89	2.91	1.10
Total	Male	93	2.96	1.17
	Female	92	2.98	1.04
	Total	185	2.97	1.10

Table 5.33

Descriptive Statistics: Ratings of Appropriateness of Psychology Major by Student Trait and Student Gender

Student Trait	Student Gender	*n*	$\overline{X}$	*s*
Help People	Male	48	4.19	1.09
	Female	48	3.81	1.09
	Total	96	4.00	1.10
High Achieving	Male	45	3.24	1.51
	Female	44	2.95	1.03
	Total	89	3.10	1.10
Total	Male	93	3.73	1.21
	Female	92	3.40	1.14
	Total	185	3.57	1.18

Table 5.34

Descriptive Statistics: Ratings of Appropriateness of High School Physics Course by Number of Years Counselor Working in Field and Student Gender

Number of Years Working	Student Gender	*n*	$\overline{X}$	*s*
1_5	Male	34	3.91	1.29
	Female	33	3.91	1.28
	Total	67	3.91	1.32
5_10	Male	19	4.63	0.68
	Female	21	4.52	0.68
	Total	40	4.58	0.68
10_15	Male	17	4.71	0.47
	Female	16	4.31	0.87
	Total	33	4.52	0.71
15_20	Male	12	4.50	0.80
	Female	8	4.25	1.39
	Total	20	4.40	1.05
20 +	Male	10	4.70	0.48
	Female	13	4.23	0.60
	Total	23	4.43	0.59
Total	Male	92	4.37	0.98
	Female	91	4.20	1.08
	Total	183	4.28	1.03

Table 5.35

Descriptive Statistics: Ratings of Appropriateness of High School AP English Course by Number of Years Counselor Working in Field and Student Gender

Number of Years Working	Student Gender	*n*	$\overline{X}$	*s*
1_5	Male	34	3.56	1.31
	Female	33	3.33	1.29
	Total	67	3.45	1.29
5_10	Male	19	4.00	0.94
	Female	21	4.14	1.01
	Total	40	4.08	0.97
10_15	Male	17	4.29	0.77
	Female	16	4.13	0.72
	Total	33	4.21	0.74
15_20	Male	12	4.00	0.95
	Female	8	3.63	1.19
	Total	20	3.85	1.04
20 +	Male	10	4.2	0.79
	Female	13	4.46	0.78
	Total	23	4.35	0.78
Total	Male	92	3.91	1.08
	Female	91	3.85	1.14
	Total	183	3.88	1.10

Table 5.36

Descriptive Statistics: Ratings of Appropriateness of High School Calculus Course by Number of Years Counselor Working in Field and Student Gender

Number of Years Working	Student Gender	*n*	$\overline{X}$	*s*
1_5	Male	34	4.09	1.26
	Female	33	3.88	1.39
	Total	67	3.99	1.32
5_10	Male	19	4.58	0.61
	Female	21	4.33	0.80
	Total	40	4.45	0.71
10_15	Male	17	4.71	0.47
	Female	16	4.31	0.60
	Total	33	4.52	0.60
15_20	Male	12	4.33	0.78
	Female	8	4.38	1.41
	Total	20	4.35	1.04
20 +	Male	10	4.6	0.70
	Female	13	4.62	0.51
	Total	23	4.61	0.58
Total	Male	92	4.39	0.94
	Female	91	4.21	1.07
	Total	183	4.3	0.101

Table 5.37

Descriptive Statistics: Ratings of Appropriateness of High School AP Psychology Course by Number of Years Counselor Working in Field and Student Gender

Number of Years Working	Student Gender	*n*	$\overline{X}$	*s*
1_5	Male	34	3.85	1.35
	Female	33	3.48	1.50
	Total	67	3.67	1.35
5_10	Male	19	4.05	0.85
	Female	21	4.33	0.86
	Total	40	4.20	0.85
10_15	Male	17	4.29	0.85
	Female	16	4.19	0.66
	Total	33	4.24	0.75
15_20	Male	12	4.67	0.65
	Female	8	3.87	0.64
	Total	20	4.35	0.75
20 +	Male	10	4.4	0.84
	Female	13	3.92	0.76
	Total	23	4.13	0.82
Total	Male	92	4.14	1.07
	Female	91	3.9	1.06
	Total	183	4.02	1.06

Table 5.38

Descriptive Statistics: Ratings of Appropriateness of High School Practical Job-Readiness Training Courses by Number of Years Counselor Working in Field and Student Gender

Number of Years Working	Student Gender	*n*	$\overline{X}$	*s*
1_5	Male	34	2.79	1.25
	Female	33	2.88	1.36
	Total	67	2.84	1.30
5_10	Male	19	3.05	0.97
	Female	21	3.1	1.48
	Total	40	3.08	1.25
10_15	Male	17	2.82	1.24
	Female	16	3.44	0.96
	Total	33	3.12	1.14
15_20	Male	12	3.33	1.56
	Female	8	4.00	1.07
	Total	20	3.60	1.39
20 +	Male	10	2.6	0.70
	Female	13	2.23	1.01
	Total	23	2.39	0.89
Total	Male	92	2.9	1.19
	Female	91	3.03	1.32
	Total	183	2.97	1.25

Table 5.39

Descriptive Statistics: Ratings of Appropriateness of Education Major by Number of Years Counselor Working in Field and Student Gender

Number of Years Working	Student Gender	*n*	$\overline{X}$	*s*
1_5	Male	35	3.57	1.27
	Female	33	3.33	1.29
	Total	68	3.46	1.28
5_10	Male	19	4.37	0.70
	Female	21	4.19	0.87
	Total	40	4.26	0.78
10_15	Male	17	4.12	0.86
	Female	17	3.88	1.05
	Total	34	4.00	0.95
15_20	Male	12	3.75	1.29
	Female	8	3.13	1.13
	Total	20	3.50	1.24
20 +	Male	10	4.10	0.74
	Female	13	3.46	1.13
	Total	23	3.74	1.01
Total	Male	93	3.91	1.08
	Female	92	3.63	1.17
	Total	185	3.77	1.13

Table 5.40

Descriptive Statistics: Ratings of Appropriateness of Biology/Premedicine Major by Number of Years Counselor Working in Field and Student Gender

Number of Years Working	Student Gender	*n*	$\overline{X}$	*s*
1_5	Male	35	4.14	1.29
	Female	33	3.88	1.36
	Total	68	4.01	1.32
5_10	Male	19	4.73	0.56
	Female	21	4.71	0.56
	Total	40	4.73	0.55
10_15	Male	17	4.82	0.53
	Female	17	4.29	0.99
	Total	34	4.56	0.82
15_20	Male	12	4.25	1.22
	Female	8	4.25	1.39
	Total	20	4.25	1.25
20 +	Male	10	4.60	0.52
	Female	13	4.46	0.66
	Total	23	4.52	0.59
Total	Male	93	4.45	1.01
	Female	92	4.26	1.10
	Total	185	4.36	1.05

Table 5.41

Descriptive Statistics: Ratings of Appropriateness of Engineering Major by Number of Years Counselor Working in Field and Student Gender

Number of Years Working	Student Gender	*n*	$\overline{X}$	*s*
1_5	Male	35	3.43	1.38
	Female	33	3.64	1.34
	Total	68	3.53	1.36
5_10	Male	19	4.16	1.02
	Female	21	3.90	0.77
	Total	40	4.03	0.89
10_15	Male	17	4.35	0.79
	Female	17	3.76	1.03
	Total	34	4.06	0.95
15_20	Male	12	3.75	1.14
	Female	8	4.13	0.84
	Total	20	3.90	1.02
20 +	Male	10	4.10	0.99
	Female	13	4.15	.90
	Total	23	4.13	0.92
Total	Male	93	3.86	1.19
	Female	92	3.84	1.07
	Total	185	3.85	1.13

Table 5.42

Descriptive Statistics: Ratings of Appropriateness of Prenursing Major by Number of Years Counselor Working in Field and Student Gender

Number of Years Working	Student Gender	*n*	$\overline{X}$	*s*
1_5	Male	35	3.69	1.35
	Female	33	3.45	1.20
	Total	68	3.57	1.27
5_10	Male	19	4.53	0.84
	Female	21	4.33	1.06
	Total	40	4.43	0.93
10_15	Male	17	4.53	0.87
	Female	17	4.00	1.06
	Total	34	4.26	0.99
15_20	Male	12	3.92	1.31
	Female	8	3.63	1.30
	Total	20	3.80	1.28
20 +	Male	10	3.7	0.95
	Female	13	3.92	1.20
	Total	23	3.83	1.07
Total	Male	93	4.04	1.18
	Female	92	3.83	1.17
	Total	185	3.94	1.18

Table 5.43

Descriptive Statistics: Ratings of Appropriateness of Finance Major by Number of Years Counselor Working in Field and Student Gender

Number of Years Working	Student Gender	*n*	$\overline{X}$	*s*
1_5	Male	35	2.74	1.15
	Female	33	2.76	1.15
	Total	68	2.75	1.14
5_10	Male	19	3.05	1.27
	Female	21	2.90	0.94
	Total	40	2.97	1.10
10_15	Male	17	3.24	1.30
	Female	17	3.24	1.15
	Total	34	3.24	1.21
15_20	Male	12	3.00	1.04
	Female	8	3.25	0.89
	Total	20	3.10	0.97
20 +	Male	10	3.00	1.05
	Female	13	3.15	0.80
	Total	23	3.09	0.97
Total	Male	93	2.96	1.17
	Female	92	2.98	1.04
	Total	185	2.97	1.10

Table 5.44

Descriptive Statistics: Ratings of Appropriateness of Psychology Major by Number of Years Counselor Working in Field and Student Gender

Number of Years Working	Student Gender	*n*	$\overline{X}$	*s*
1_5	Male	35	3.51	1.44
	Female	33	3.12	1.14
	Total	68	3.32	1.31
5_10	Male	19	4.11	0.74
	Female	21	3.90	1.04
	Total	40	4.00	0.91
10_15	Male	17	4.00	1.12
	Female	17	3.76	1.20
	Total	34	3.88	1.15
15_20	Male	12	3.83	1.19
	Female	8	3.00	0.76
	Total	20	3.50	1.10
20 +	Male	10	3.20	1.03
	Female	13	2.08	1.12
	Total	23	3.50	1.06
Total	Male	93	3.73	1.21
	Female	92	3.4	1.14
	Total	185	3.57	1.18

Table 5.45

Post-hoc Analysis of the Effects of The Number of Years Working as a Counselor on Ratings of Appropriateness of High School Physics Course

Number of Years Working		Mean	Mean Difference	Significance
1_5	1_5	3.91		
	5_10	4.58	-0.66	0.01
	10_15	4.52	-0.60	0.04
	15_20	4.40	-0.49	0.32
	20 +	4.43	-0.52	0.20
5_10	10_15	4.52	0.06	1.00
	15_20	4.40	0.18	0.97
	20 +	4.43	0.14	0.98
10_15	15_20	4.40	0.12	0.99
	20 +	4.43	0.08	1.00
15_20	20 +	4.43	0.97	1.00

Table 5.46

Post-hoc Analysis of the Effects of The Number of Years Working as a Counselor on Ratings of Appropriateness of High School AP English Course

Number of Years Working		Mean	Mean Difference	Significance
1_5	1_5	3.45		
	5_10	4.08	-0.63	0.03
	10_15	4.21	-0.76	0.01
	15_20	3.85	-0.40	0.58
	20 +	4.35	-0.90	0.01
5_10	10_15	4.21	-0.14	0.98
	15_20	3.85	0.22	0.94
	20 +	4.35	0.76	0.86
10_15	15_20	3.85	0.36	0.75
	20 +	4.35	-0.14	0.99
15_20	20 +	4.35	-0.50	0.55

Table 5.47

Post-hoc Analysis of the Effects of The Number of Years Working as a Counselor on Ratings of Appropriateness of High School Calculus Course

Number of Years Working		Mean	Mean Difference	Significance
1_5	1_5	3.99		
	5_10	4.45	-0.46	0.14
	10_15	4.52	-0.53	0.09
	15_20	4.35	-0.36	0.60
	20 +	4.61	-0.54	0.08
5_10	10_15	4.52	-0.07	1.00
	15_20	4.35	1.00	1.00
	20 +	4.61	-0.16	1.00
10_15	15_20	4.35	-0.17	0.98
	20 +	4.61	-0.26	1.00
15_20	20 +	4.61	-0.26	0.91

Table 5.48

Post-hoc Analysis of the Effects of The Number of Years Working as a Counselor on Ratings of Appropriateness of High School AP Psychology Course

Number of Years Working		Mean	Mean Difference	Significance
1_5	1_5	3.67		
	5_10	4.20	-0.53	0.08
	10_15	4.24	-0.57	0.08
	15_20	4.35	-0.68	0.08
	20 +	4.13	-0.46	0.36
5_10	10_15	4.24	-0.04	1.00
	15_20	4.35	-0.15	0.98
	20 +	4.13	0.07	1.00
10_15	15_20	4.35	-0.11	1.00
	20 +	4.13	0.11	1.00
15_20	20 +	4.13	0.22	0.96

Table 5.49

Post-hoc Analysis of the Effects of The Number of Years Working as a Counselor on Ratings of Appropriateness of High School Practical Job-Readiness Training Courses

Number of Years Working		Mean	Mean Difference	Significance
1_5	1_5	2.84		
	5_10	3.08	-0.24	0.87
	10_15	3.12	-0.29	0.81
	15_20	3.60	-0.76	0.11
	20 +	2.39	0.44	0.57
5_10	10_15	3.12	-0.05	1.00
	15_20	3.60	-0.48	0.53
	20 +	2.39	0.68	0.21
10_15	15_20	3.60	-0.48	0.65
	20 +	2.39	0.73	0.19
15_20	20 +	2.39	1.21	0.14

Table 5.50

Post-hoc Analysis of the Effects of The Number of Years Working as a Counselor on Ratings of Appropriateness of Education Major

Number of Years Working		Mean	Mean Difference	Significance
1_5	1_5	3.46		
	5_10	4.26	-0.82	0.00
	10_15	4.00	-0.54	0.13
	15_20	3.50	-0.04	1.00
	20 +	3.74	-0.28	0.81
5_10	10_15	4.00	0.27	0.82
	15_20	3.50	0.77	0.08
	20 +	3.74	0.54	0.33
10_15	15_20	3.50	0.50	0.48
	20 +	3.74	0.26	0.90
15_20	20 +	3.74	-0.24	0.95

Table 5.51

Post-hoc Analysis of the Effects of The Number of Years Working as a Counselor on Ratings of Appropriateness of Biology/Premedicine Major

Number of Years Working		Mean	Mean Difference	Significance
1_5	1_5	4.01		
	5_10	4.73	-0.71	0.01
	10_15	4.56	-0.54	0.09
	15_20	4.25	0.24	0.90
	20 +	4.52	-0.51	0.25
5_10	10_15	4.73	0.17	0.96
	15_20	4.56	0.47	0.45
	20 +	4.52	0.20	0.94
10_15	15_20	4.56	0.31	0.82
	20 +	4.52	0.04	0.91
15_20	20 +	4.52	-0.27	0.91

Table 5.52

Post-hoc Analysis of the Effects of The Number of Years Working as a Counselor on Ratings of Appropriateness of Engineering Major

Number of Years Working		Mean	Mean Difference	Significance
1_5	1_5	3.53		
	5_10	4.03	-0.07	0.17
	10_15	4.06	-0.53	0.16
	15_20	3.90	-0.37	0.69
	20 +	4.13	-0.60	0.17
5_10	10_15	4.06	-0.03	1.00
	15_20	3.90	0.13	0.99
	20 +	4.13	-0.11	1.00
10_15	15_20	3.90	0.16	0.99
	20 +	4.13	-0.07	1.00
15_20	20 +	4.13	-0.23	0.96

Table 5.53

Post-hoc Analysis of the Effects of The Number of Years Working as a Counselor on Ratings of Appropriateness of Prenursing Major

Number of Years Working		Mean	Mean Difference	Significance
1_5	1_5	3.57		
	5_10	4.43	-0.85	0.00
	10_15	4.26	-0.69	0.04
	15_20	3.80	-0.23	0.94
	20 +	3.83	-0.25	0.89
5_10	10_15	4.26	0.16	0.97
	15_20	3.80	0.63	0.27
	20 +	3.83	0.60	0.27
10_15	15_20	3.80	0.46	0.60
	20 +	3.83	0.44	0.61
15_20	20 +	3.83	-0.03	1.00

Table 5.54

Post-hoc Analysis of the Effects of The Number of Years Working as a Counselor on Ratings of Appropriateness of Finance Major

Number of Years Working		Mean	Mean Difference	Significance
1_5	1_5	2.75		
	5_10	2.97	0.23	0.85
	10_15	3.24	-0.49	0.24
	15_20	3.10	-0.35	0.73
	20 +	3.09	-0.34	0.72
5_10	10_15	3.24	-0.26	0.85
	15_20	3.10	-0.13	0.99
	20 +	3.09	-0.11	1.00
10_15	15_20	3.10	0.14	0.99
	20 +	3.09	0.15	1.00
15_20	20 +	3.09	0.01	1.00

Table 5.55

Post-hoc Analysis of the Effects of The Number of Years Working as a Counselor on Ratings of Appropriateness of Psychology Major

Number of Years Working		Mean	Mean Difference	Significance
1_5	1_5	3.32		
	5_10	4.00	-0.68	0.03
	10_15	3.88	-0.56	0.15
	15_20	3.50	-0.18	0.97
	20 +	3.50	0.19	0.96
5_10	10_15	3.88	0.12	0.99
	15_20	3.50	0.50	0.51
	20 +	3.50	0.87	0.04
10_15	15_20	3.50	0.38	0.76
	20 +	3.50	0.75	0.11
15_20	20 +	3.50	0.37	0.83

Table 5.56

Descriptive Statistics: Ratings of Appropriateness of High School Physics Course by Number of Years Counselor Working in Field and Student Trait

Number of Years Working	Student Trait	*n*	$\overline{X}$	*s*
1_5	HP	33	3.72	1.40
	HA	35	4.09	1.25
	Total	68	3.91	1.32
				0.72
5_10	HP	24	4.46	0.72
	HA	16	4.75	0.58
	Total	40	4.58	0.68
10_15	HP	20	4.50	0.76
	HA	14	4.54	0.66
	Total	34	4.52	0.71
15_20	HP	11	4.45	0.82
	HA	9	4.33	1.32
	Total	20	4.40	1.05
20 +	HP	8	4.38	0.74
	HA	15	4.47	0.52
	Total	23	4.43	0.59
Total	HP	96	4.21	1.06
	HA	89	4.36	1.00
	Total	185	4.28	1.03

Table 5.57

Descriptive Statistics: Ratings of Appropriateness of High School AP English Course by Number of Years Counselor Working in Field and Student Trait

Number of Years Working	Student Trait	*n*	$\overline{X}$	*s*
1_5	HP	32	2.59	1.48
	HA	35	3.31	1.11
	Total	67	3.45	1.29
5_10	HP	24	4.12	0.90
	HA	16	4.00	1.10
	Total	40	4.08	0.97
10_15	HP	20	4.15	0.75
	HA	13	4.31	0.75
	Total	33	4.21	0.74
15_20	HP	11	3.91	,83
	HA	9	3.78	1.30
	Total	20	3.85	1.04
20 +	HP	8	4.50	0.76
	HA	15	4.27	.80
	Total	23	4.35	0.78
Total	HP	95	3.96	1.11
	HA	88	3.80	1.10
	Total	183	3.88	1.10

Table 5.58

Descriptive Statistics: Ratings of Appropriateness of High School Calculus Course by Number of Years Counselor Working in Field and Student Trait

Number of Years Working	Student Trait	*n*	$\overline{X}$	*s*
1_5	HP	32	3.81	1.38
	HA	35	4.14	1.26
	Total	67	3.99	1.32
5_10	HP	24	4.29	0.75
	HA	16	4.69	.60
	Total	40	4.45	0.71
10_15	HP	20	4.45	0.61
	HA	13	4.62	0.51
	Total	33	4.52	0.57
15_20	HP	11	4.36	0.81
	HA	9	4.33	1.32
	Total	20	4.35	1.04
20 +	HP	8	4.88	0.35
	HA	15	4.47	0.64
	Total	23	4.61	0.58
Total	HP	95	4.22	1.01
	HA	88	4.39	1.00
	Total	183	4.30	1.01

Table 5.59

Descriptive Statistics: Ratings of Appropriateness of High School AP Psychology Course by Number of Years Counselor Working in Field and Student Trait

Number of Years Working	Student Trait	*n*	$\overline{X}$	*s*
1_5	HP	32	3.78	1.35
	HA	35	3.57	1.5
	Total	67	3.67	1.35
5_10	HP	24	4.29	0.85
	HA	16	4.06	0.86
	Total	40	4.20	0.85
10_15	HP	20	4.40	0.85
	HA	13	4.00	0.66
	Total	33	4.20	0.75
15_20	HP	11	4.64	0.65
	HA	9	4.00	0.64
	Total	20	4.24	0.75
20 +	HP	8	4.64	0.84
	HA	15	4.00	0.76
	Total	23	4.35	0.82
Total	HP	95	4.21	1.07
	HA	88	3.82	1.06
	Total	183	4.02	1.06

Table 5.60

Descriptive Statistics: Ratings of Appropriateness of High School Practical Job-Readiness Training Courses by Number of Years Counselor Working in Field and Student Trait

Number of Years Working	Student Trait	*n*	$\overline{X}$	*s*
1_5	HP	32	2.97	1.51
	HA	35	2.71	1.07
	Total	67	2.84	1.30
5_10	HP	24	3.17	1.17
	HA	16	2.94	1.39
	Total	40	3.08	1.25
10_15	HP	20	3.15	1.14
	HA	13	3.08	1.19
	Total	33	3.12	1.14
15_20	HP	11	3.91	1.22
	HA	9	3.22	1.56
	Total	20	3.60	1.14
20 +	HP	8	2.63	1.06
	HA	15	2.27	0.80
	Total	23	2.39	0.89
Total	HP	95	3.14	1.30
	HA	88	2.78	1.18
	Total	183	2.98	1.25

Table 5.61

Descriptive Statistics: Ratings of Appropriateness of Education Major by Number of Years Counselor Working in Field and Student Trait

Number of Years Working	Student Trait	*n*	$\overline{X}$	*s*
1_5	HP	33	3.88	1.39
	HA	35	3.06	1.03
	Total	68	3.46	1.28
5_10	HP	24	4.50	.70
	HA	16	3.94	0.85
	Total	40	4.28	0.78
10_15	HP	20	4.30	0.73
	HA	14	3.57	1.09
	Total	34	4.00	0.95
15_20	HP	11	3.55	1.44
	HA	9	3.44	1.01
	Total	20	3.50	1.24
20 +	HP	8	3.75	1.04
	HA	15	3.73	1.03
	Total	23	3.74	1.01
Total	HP	93	4.07	1.13
	HA	92	3.45	1.05
	Total	185	3.77	1.13

Table 5.62

Descriptive Statistics: Ratings of Appropriateness of Biology/Premedicine Major by Number of Years Counselor Working in Field and Student Trait

Number of Years Working	Student Trait	*n*	$\overline{X}$	*s*
1_5	HP	33	4.03	1.38
	HA	35	4.00	1.28
	Total	68	4.01	1.32
5_10	HP	24	4.75	0.53
	HA	16	4.69	0.60
	Total	40	4.73	0.55
10_15	HP	20	4.60	0.60
	HA	14	4.50	0.55
	Total	34	4.56	0.82
15_20	HP	11	4.18	1.60
	HA	9	4.33	0.71
	Total	20	4.25	1.25
20 +	HP	8	4.88	0.35
	HA	15	4.33	0.62
	Total	23	4.52	0.59
Total	HP	96	4.42	1.08
	HA	89	4.29	1.03
	Total	185	4.36	1.05

Table 5.63

Descriptive Statistics: Ratings of Appropriateness of Engineering Major by Number of Years Counselor Working in Field and Student Trait

Number of Years Working	Student Trait	*n*	$\overline{X}$	*s*
1_5	HP	33	3.09	1.26
	HA	35	3.94	1.33
	Total	68	3.53	1.36
5_10	HP	24	3.67	0.82
	HA	16	4.56	0.73
	Total	40	4.03	0.89
10_15	HP	20	4.00	0.80
	HA	14	4.14	1.17
	Total	34	4.06	0.95
15_20	HP	11	3.36	0.92
	HA	9	4.56	0.73
	Total	20	3.90	1.02
20 +	HP	8	3.88	0.99
	HA	15	4.27	0.88
	Total	23	4.13	0.92
Total	HP	96	3.52	1.06
	HA	89	4.20	1.10
	Total	185	3.85	1.13

Table 5.64

Descriptive Statistics: Ratings of Appropriateness of Prenursing Major by Number of Years Counselor Working in Field and Student Trait

Number of Years Working	Student Trait	*n*	$\overline{X}$	*s*
1_5	HP	33	3.82	1.33
	HA	35	3.34	1.19
	Total	68	3.57	1.27
5_10	HP	24	4.75	0.53
	HA	16	3.94	1.18
	Total	40	4.43	0.93
10_15	HP	20	4.55	0.61
	HA	14	3.86	1.29
	Total	34	4.26	0.99
15_20	HP	11	3.82	1.54
	HA	9	3.78	0.97
	Total	20	3.80	1.28
20 +	HP	8	4.75	0.46
	HA	15	3.33	0.98
	Total	23	3.83	1.07
Total	HP	96	4.28	1.09
	HA	89	3.57	1.16
	Total	185	3.94	1.18

Table 5.65

Descriptive Statistics: Ratings of Appropriateness of Finance Major by Number of Years Counselor Working in Field and Student Trait

Number of Years Working	Student Trait	*n*	$\overline{X}$	*s*
1_5	HP	33	2.70	1.19
	HA	35	2.80	1.11
	Total	68	2.75	1.14
5_10	HP	24	2.92	1.02
	HA	16	3.06	1.24
	Total	40	2.97	1.10
10_15	HP	20	3.50	1.00
	HA	14	2.86	1.41
	Total	34	3.24	1.21
15_20	HP	11	3.00	1.18
	HA	9	3.22	0.67
	Total	20	3.10	0.97
20 +	HP	8	3.50	0.77
	HA	15	2.87	0.92
	Total	23	3.09	0.90
Total	HP	96	3.02	1.11
	HA	89	2.91	1.10
	Total	185	2.97	1.10

Table 5.66

Descriptive Statistics: Ratings of Appropriateness of Psychology Major by Number of Years Counselor Working in Field and Student Trait

Number of Years Working	Student Trait	*n*	$\overline{X}$	*s*
1_5	HP	33	3.76	1.35
	HA	35	2.91	1.15
	Total	68	3.32	1.31
5_10	HP	24	4.25	1.00
	HA	16	3.62	0.81
	Total	40	4.00	0.91
10_15	HP	20	4.35	0.67
	HA	14	3.21	1.37
	Total	34	3.88	1.15
15_20	HP	11	4.35	1.29
	HA	9	3.21	0.87
	Total	20	3.88	1.10
20 +	HP	8	3.64	0.84
	HA	15	3.33	0.96
	Total	23	3.50	1.06
Total	HP	96	4.00	1.10
	HA	89	3.10	1.10
	Total	185	3.57	1.18

CHAPTER 6

CONCLUSION

The main objective of this work was to conduct an initial examination of the gender disparity in STEM and engineering college majors and professional careers. To meet this objective, the research work was divided into three parts: 1) conducting a statistical study of school students' expressed interest in STEM and engineering careers and majors; 2) developing and conducting a survey to examine the role of school counselors in guiding and influencing students' engineering-related education and career decisions; and 3) constructing a vignette study to further examine counselor attitudes about the appropriateness of high school courses and college majors for male and female students who differ on personal attributes.

Several conclusions can be drawn from the results of the studies described above. First, interest in the STEM fields has been greatly differentiated between male and female students for the last 30 years. The gender differences in math and science-related interests observed for the last 100 years appear to have persisted over the last 30 years with little to no attenuation. Further, there appears to be a mismatch between expressed interests and academic achievement. Those who express strong interest in engineering are not always well prepared to enter the field in college, and there appear to be large numbers of students who are prepared to succeed in math and science-intensive careers who do not express interest in those areas. These findings point to the importance of early and aggressive educational guidance beginning as early as high school age. Clearly, students with math achievement scores of less than 19 on the ACT will struggle in most pre-professional engineering training programs, yet there appear to be large numbers of these students who expressed interest in engineering. Presumably high school counselors have access to these data and could use it to help students identify more realistic career options such as engineering-related technical training. Alternatively, school counselors could use these data to target students for effective math remediation.

Our findings suggest that students may not have an accurate understanding of the preparation necessary to succeed in engineering (or perhaps other) career fields. Engineering-related disciplines require strong math and science aptitude, potential that many students expressing interest in engineering appear to lack. School counselors may need to attend to this gap when conducting individual or course-based career guidance activities. Most existing comprehensive computer-based career guidance programs include information about career and related college majors and make use of the O*NET data that specifies the skills and aptitudes needed. Counselors could supplement these data with specific information about the admissions requirements for undergraduate institutions in their state and include alternative routes to engineering and engineering-technical training (e.g., applied colleges of technology, beginning with a 2-year associates degree in a related field to bring math and science achievement scores up, etc.).

One intervention may be to coordinate with high school career counselors in order to obtain information on exactly how students are being counseled and guided towards choosing their majors. These observations also make a case for continued efforts to encourage young women to enter engineering and related careers through early intervention from teachers and guidance from counselors (Sonnert, Fox, & Adkins, 2007). Based on existing research, such efforts should focus not only on identifying and promoting math, science, and engineering interests in young women, but also on the past math and science achievement of these students. Strong past achievement is likely to be associated with strong positive self-efficacy beliefs, which, according to the literature, are potent determinants of behavioral initiation and persistence (Lent, Lopez, Brown & Gore, 1996).

State and district data from ACT could be used by district-level educators and policy makers to target students with strong academic backgrounds who have expressed interest congruent with engineering but who are not explicitly aspiring to engineering-related careers. Interventions directed at these students might include efforts to promote awareness of engineering careers and their potential for success in those careers.

Given the established gender disparity in interest, and the perceived lack of information students who expressed interest seemed to have about the engineering major, a second study was established to further examine the potential role of the school counselor. Elementary and secondary school counselors are in a position to positively (or negatively) influence the academic and career choices of the students they advise through encouraging course enrollment, career guidance curriculum and exploration, and as liaisons to parents and teachers. Given their importance in the initial educational and career decision-making process, the attitudes and beliefs of school counselors with respect to engineering careers warrant further investigation.

Results from our first survey suggest that Utah school counselors demonstrate a lack of knowledge about engineering, and may come to different conclusion about a student's appropriateness for engineering based on student gender. This may be explained in part by the fact that engineering is not a traditionally female occupation, and counselors believe that the values and attributes associated with engineering are incongruent with the values of female students in the general population. School counselors did display a relatively accurate understanding of the gender disparity, but attributed values to male and female students regarding their pursuit of engineering as a career. Further, many counselors' understanding of the admissions standards for engineering programs were incorrect. Such inaccuracies may lead counselors to dissuade qualified students, or encourage unqualified students to pursue engineering careers. Lastly, school counselors seem to uphold traditional gender roles in their work with students. Often, traditionally female interests were seen as incompatible with the traditionally male field of engineering. This was also true in that traditionally male interests were often reported to be more compatible with engineering. Both these observations seem to lead to the fact that school counselors may be impacted by societal influences with regard to traditionally male/female fields and that these biases may be having an effect on how they aid students in career choice decision making.

Our survey helped inform study three by pinpointing specific areas in which differences in counselors' responses are due to student gender. Study two findings were partially replicated in the vignette study. Findings from this study confirmed that both male and female counselors find different careers more or less appropriate for students based on both student gender and student personality attributes.

Generally, the data seems to indicate that male counselors are more likely to be influenced by the gender of a student when considering possible career options compared to their female counterparts, and that male counselors are more likely to have a larger discrepancy between their responses to males and females regarding what courses and majors are appropriate compared to female counselors. With the exception of the psychology major, it seems that both male and female counselors display some difference in their ideas of what personality attributes may be appropriate for certain courses and majors.

Based on student gender and personality attributes, counselors of both genders demonstrated striking differences in what they perceived to be an appropriate student for an engineering major. Both male and female counselors deemed engineering as less appropriate overall for female students than for male students. Further, in categorizing one student as "socially engaged and involved in student activities while expressing a strong desire to help others" as opposed to "being a non-conformist and expressing interest in a work environment in which achievement is highly valued and where she will receive recognition for her hard work" while keeping all other components of the description of the students consistent (interest in classes and achievement), counselors determined that helping people characteristics made a student less appropriate for an engineering major.

It may be inferred that the difference in counselor responses may be related to the gender disparity in engineering fields and may in part be attributed to societal stereotypes and expectation of gender roles in traditionally male or female careers. These findings seem to suggest that students may be receiving different career guidance from their school counselors based on their gender and personality characteristics. It seems these differences are likely to be influenced by gender stereotypes concerning interests and values. Further, it seems that traditionally male careers continue to be seen as "male careers," despite reported interest and ability by hypothetical female students. These findings, though not surprising, are disheartening in that they demonstrate one piece of the puzzle that continues to keep qualified and interested females from perusing majors and careers in the STEM fields.

Based on this research, we have demonstrated a clear and present issue in the work school counselors may be doing with students. The differences in counselors' answers based on gender and personality characteristics lead to concern about how these interactions may be translating into important career decisions. The course decisions students make in junior high and high school may influence their entire life course, and thus early and fair interventions seem to be warranted in addressing the ways school counselors' beliefs may be impacting student decision making. Further, it is important to recognize that these differences are societal in nature and may be further enforced by parents and teachers. Educating those with influence on students' career decision-making process will be an important aspect of decreasing the unwarranted differences in perception that may influence students.

Further, understanding the influence counselors have on students, further investigation of counselor training around gender bias, societal influences, and traditionally male and female careers seems warranted. Clearly such attitudes and beliefs become problematic as they may be translated into specific academic and career-related advising recommendations. Interventions that make counselors aware of their biases might be an appropriate first step in preventing the potential negative impact of those biases. Further, training around what specific careers entail may be important to further combat stereotypes. Increased didactic training in order to sharpen knowledge about what information a counselor should be synthesizing in order to best aid students in career decision making would also be important training. For instance, investigating the weight of the student's self-reported interest compared to his/her academic achievement and perceived interests (based on classes) are all-important factors. It also seems important, however, to be open to sharing new information and career opportunities based on scholarship availability, job opportunities and earning potential.

Information on how societal biases impact us all, as well as the importance of acknowledging and working towards awareness of these biases, is the first step in eradicating their influence on the decision making process. Lastly, continuing to encourage qualified female students to pursue these fields through scholarship, mentorship and opportunity is critical. Together, these interventions may continue to illuminate new strategies to aid in decreasing the problematic nature of the gender disparity in STEM fields.

Future work will consist of the distribution of this information to school counseling training programs in the hopes of encouraging awareness about the biases that may be held. Though this training will include information about engineering as a discipline, the majority of the work will consist of increase acknowledgement of bias in order to actively work at combating its influence in working with students. Further, we will produce and distribute a set of potential guidelines that may help counselors use specific information to aid students in matching their interests, values, personality characteristics and goals with the optimal major or career.

In addition to counselor training, future research will include the investigation of the gender disparity in STEM fields in different parts of the world. As it has been demonstrated that this disparity does not appear in all countries, we plan to investigate the contributing factors that may be causing these differences. Collecting similar vignette data from other countries would allow us to find similarities and differences in the way people view gender and personality attributes in engineering related fields. This may allow us to draw conclusions as to what the United States may be able to do differently in order to decrease the disparity.

Lastly, it may be important to continue this research with others who may have an influence with student career and major decision making. For example, investigating the role and beliefs of parents and teachers may be an important step in increasing awareness and decreasing the disparity. Vignettes similar to those used in the third study could be crafted in order to delve further into whether these differences in belief of what attributes/gender make a person appropriate for an engineering related major or career are also prevalent in teachers and parents. This may lead to insight into how we may be able to best work with these populations to decrease the disparity.

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